



January 28, 2013
L-2013-040
10 CFR 50.36

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555-0001

Re: Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
Wastewater Permit Number FL0001562
Request for One Time Use of Polyacrylic Acid - Notification

In accordance with Section 3.2.3 of the Turkey Point Units 3 and 4 Environmental Protection Plan (Appendix B of Facility Operating Licenses DPR-31 and DPR-41), enclosed is a copy of the request for approval of a one time use of Polyacrylic Acid (PAA) dispersant in the Turkey Point Unit 4 secondary system. The request for use and discharge of PAA is being submitted as a Maintenance Activity to the Wastewater Permit Number FL0001562.

Should there be any questions, please contact us.

Very truly yours,

Michael Kiley
Site Vice President
Turkey Point Nuclear Plant

Enclosure

cc: Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant

C001
NRR

ENCLOSURE TO

L-2013-040



January 28, 2013

Marc Harris
FDEP Permitting Supervisor – Power Plant NPDES Program
Florida Department of Environmental Protection
Division of Permitting Management
2600 Blair Stone Road
Tallahassee, FL 32399-2400

RE: FPL-Turkey Point Power Plant Wastewater Permit FLO0O1562
Maintenance Activity:
Request for one time use of Polyacrylic Acid (PAA)

Mr. Harris,

The purpose of this correspondence is to request Department approval for a one time use of a Polyacrylic Acid (PAA) dispersant (GE Optisperse PWR6600 containing 10% PAA) in the Turkey Point Unit 4 secondary system. The request for use and discharge of PAA is submitted as a Maintenance Activity to the Wastewater Permit.

Below please find the information required by Part E, Section 9, of the Wastewater Permit for uses of new chemicals. FPL used this requirement, as well as previous similar requests for chemicals to be used in these one-time maintenance activities as guidance for this submittal.

1. Name and general composition of the chemicals:

See **Attachment 1** GE Optisperse PWR6600 Material Safety Data Sheet and **Attachment 2** GE Optisperse PWR6600 Certificate of Analysis.

2. Frequency of use:

PAA use will be a one time batch add with minor make up as needed at or below the dosing concentration referenced in **Attachment 3** Turkey Point Unit 4 - Dispersant Modeling for Flush Application.

3. Quantities to be used:

PAA will be batch added at a concentration of 1 parts per million for all affected systems. See **Attachment 3** Turkey Point Unit 4 - Dispersant Modeling for Flush Application. A maximum total of 20 gallons of GE Optisperse PWR6600 containing 10% PAA will be used.

4. Proposed effluent concentrations:

The PAA model (see **Attachment 3**) establishes a target concentration of one part per million for the system flush. A maximum total of 20 gallons of GE Optisperse PWR6600 product will be used over a three to six week cleanup period. The PAA will be slowly diluted out of the secondary system through feed and bleed. This process results in a discharge of PAA to the canal system at a concentration ranging from 0.4 parts per billion to 1.7 parts per billion. The discharge concentration is based on the number of circulating water pumps in use. The 0.4 parts per billion value is the expected release concentration based on forecasted pump availability.

5. Any acute and chronic toxicity data:

Reference **Attachment 1** Optisperse PWR6600 Material Safety Data Sheet and **Attachment 4** Section II.B of EPA Memo "Environmental Concerns of Polymer". The active ingredient in GE Optisperse PWR6600 is PAA, a poly-anionic polymer with Molecule Weight (MW) > 1000.

6. Product data sheet:

See **Attachment 5** GE OptiSperser PWR6600 Product Data Sheet.

7. Product label:

See **Attachment 1** GE Optisperse PWR 6600 Material Safety Data Sheet.

If you have any questions on this matter, or need any additional information, please contact Ms. Renee Pfeilsticker at (305) 246-6807.

Sincerely,



Mike Kiley
Vice President Turkey Point Plant

Attachments

- Attachment 1:** GE Optisperse PWR6600 Material Safety Data Sheet,
- Attachment 2:** GE Optisperse PWR6600 Certificate of Analysis,
- Attachment 3:** Turkey Point Unit 4 - Dispersant Modeling for Flush Application, 01/28/13
- Attachment 4:** EPA Memo Environmental Concerns of Polymers, and
- Attachment 5:** GE Optisperse PWR6600 Product Data Sheet,

cc:

Gabriel Mendoza CHEM/ PTN
James Davison CHEM/ PTN
John Jones JES/ JB
PTN NPDES File

Attachment 1



Material Safety Data Sheet

Issue Date: 03-NOV-2010
Supercedes: 08-MAR-2010

OPTISPERSE PWR6600

1 Identification

Identification of substance or preparation
OPTISPERSE PWR6600

Product Application Area
Internal boiler water treatment

Company/Undertaking Identification
GE Betz, Inc.
4636 Somerton Road
Trevose, PA 19053
T 215 355-3300, F 215 953 5524

Emergency Telephone
(800) 877-1940

Prepared by Product Stewardship Group: T 215-355-3300 Prepared on: 03-NOV-2010

2 Hazard(s) identification

EMERGENCY OVERVIEW

WARNING

May cause moderate irritation to the skin. Absorbed by skin. Severe irritant to the eyes. Mists/aerosols may cause irritation to upper respiratory tract.

DOT hazard is not applicable

Odor: Slight; Appearance: Colorless To Light Yellow, Liquid

Fire fighters should wear positive pressure self-contained breathing apparatus (full face-piece type). Proper fire-extinguishing media: dry chemical, carbon dioxide, foam or water

POTENTIAL HEALTH EFFECTS

ACUTE SKIN EFFECTS:

Primary route of exposure; May cause moderate irritation to the skin. Absorbed by skin.

ACUTE EYE EFFECTS:

Severe irritant to the eyes.

ACUTE RESPIRATORY EFFECTS:

Mists/aerosols may cause irritation to upper respiratory tract.

INGESTION EFFECTS:

May cause gastrointestinal irritation with possible nausea, vomiting, headache, dizziness, unconsciousness and injury to the kidneys and liver. Small amounts aspirated during ingestion/vomiting may cause lung injury, possibly death.

TARGET ORGANS:

Prolonged or repeated exposures may cause toxicity to the liver, kidney, nervous system, and/or blood system.

MEDICAL CONDITIONS AGGRAVATED:

Not known.

SYMPTOMS OF EXPOSURE:

May cause redness or itching of skin, irritation, and/or tearing of eyes (direct contact).

3 Composition / information on ingredients

Information for specific product ingredients as required by the U.S. OSHA HAZARD COMMUNICATION STANDARD is listed. Refer to additional sections of this MSDS for our assessment of the potential hazards of this formulation.

HAZARDOUS INGREDIENTS:

Cas#	Chemical Name	Range (w/w%)
141-43-5	MONOETHANOLAMINE Combustible; corrosive; irritant; CNS depressant; may cause liver and kidney toxicity; fetotoxic and developmental toxin in laboratory animals	7-13

4 First-aid measures

SKIN CONTACT:

URGENT! Wash thoroughly with soap and water. Remove contaminated clothing. Get immediate medical attention. Thoroughly wash clothing before reuse.

EYE CONTACT:

Remove contact lenses. Hold eyelids apart. Immediately flush eyes with plenty of low-pressure water for at least 15 minutes. Get immediate medical attention.

INHALATION:

If nasal, throat or lung irritation develops - remove to fresh air and get medical attention.

INGESTION:

Do not feed anything by mouth to an unconscious or convulsive victim. Do not induce vomiting. Immediately contact physician. Dilute contents of stomach using 2-8 fluid ounces (60-240 mL) of milk or water.

NOTES TO PHYSICIANS:

Aspiration into the lungs will result in chemical pneumonia and may be fatal.

5 Fire-fighting measures

FIRE FIGHTING INSTRUCTIONS:

Fire fighters should wear positive pressure self-contained breathing apparatus (full face-piece type).

EXTINGUISHING MEDIA:

dry chemical, carbon dioxide, foam or water

HAZARDOUS DECOMPOSITION PRODUCTS:

oxides of carbon and nitrogen, ammonia and volatile amines

FLASH POINT:

> 200F > 93C P-M(CC)

6 Accidental release measures

PROTECTION AND SPILL CONTAINMENT:

Ventilate area. Use specified protective equipment. Contain and absorb on absorbent material. Place in waste disposal container. Flush area with water. Wet area may be slippery. Spread sand/grit.

DISPOSAL INSTRUCTIONS:

Water contaminated with this product may be sent to a sanitary sewer treatment facility, in accordance with any local agreement, a permitted waste treatment facility or discharged under a permit. Product as is - Incinerate or land dispose in an approved landfill.

7 Handling and storage

HANDLING:

Clean spill immediately. Wash contaminated skin promptly.

STORAGE:

Shelf life = 720 days. Keep containers closed when not in use. Protect from freezing. If frozen, thaw completely and mix thoroughly prior to use.

8 Exposure controls / personal protection

EXPOSURE LIMITS

CHEMICAL NAME

MONOETHANOLAMINE

PEL (OSHA): 3 PPM (6 MG/M3)

TLV (ACGIH): TWA = 3 PPM; STEL = 6 PPM

MISC: NIOSH REL = 3 PPM (8 MG/M3); NIOSH STEL = 6 PPM (15 MG/M3);

NIOSH IDLH = 30 PPM

ENGINEERING CONTROLS:

Adequate ventilation to maintain air contaminants below exposure limits.

PERSONAL PROTECTIVE EQUIPMENT:

Use protective equipment in accordance with 29CFR 1910 Subpart I

RESPIRATORY PROTECTION:

A RESPIRATORY PROTECTION PROGRAM THAT MEETS OSHA'S 29 CFR 1910.134 AND ANSI Z88.2 REQUIREMENTS MUST BE FOLLOWED WHENEVER WORKPLACE CONDITIONS WARRANT A RESPIRATOR'S USE.

USE AIR PURIFYING RESPIRATORS WITHIN USE LIMITATIONS ASSOCIATED WITH THE EQUIPMENT OR ELSE USE SUPPLIED AIR-RESPIRATORS.

If air-purifying respirator use is appropriate, use organic vapor cartridges and any of the following particulate respirators: N95, N99, N100, R95, R99, R100, P95, P99 or P100.

SKIN PROTECTION:

gauntlet-type butyl gloves, chemical resistant apron-- Wash off after each use. Replace as necessary.

EYE PROTECTION:

splash proof chemical goggles, face shield

9 Physical and chemical properties

Spec. Grav. (70F, 21C)	1.063	Vapor Pressure (mmHG)	~ 18.0
Freeze Point (F)	30	Vapor Density (air=1)	< 1.00
Freeze Point (C)	-1		
Viscosity(cps 70F, 21C)	133	% Solubility (water)	100.0

Odor	Slight
Appearance	Colorless To Light Yellow
Physical State	Liquid
Flash Point	P-M(CC) > 200F > 93C
pH As Is (approx.)	8.5
Evaporation Rate (Ether=1)	< 1.00
Percent VOC:	15.0

NA = not applicable ND = not determined

10 Stability and reactivity

CHEMICAL STABILITY:

Stable under normal storage conditions.

POSSIBILITY OF HAZARDOUS REACTIONS:

No known hazardous reactions.

INCOMPATIBILITIES:

May react with strong oxidizers.

DECOMPOSITION PRODUCTS:

oxides of carbon and nitrogen, ammonia and volatile amines

11 Toxicological information

Oral LD50 RAT: >2,000 mg/kg

NOTE - Estimated value

Dermal LD50 RABBIT: >2,000 mg/kg

NOTE - Estimated value

12 Ecological information

AQUATIC TOXICOLOGY

Daphnia magna 48 Hour Static Renewal Bioassay

LC50= 1250; No Effect Level= 687 mg/L

Fathead Minnow 96 Hour Static Bioassay with 48-Hour Renewal

0% Mortality= 2000 mg/L

Mysid Shrimp 96 Hour Static Renewal Bioassay

LC50= 2640; No Effect Level= 1000 mg/L

Sheepshead Minnow 96 Hour Static Renewal Bioassay

No Effect Level= 8000 mg/L

BIODEGRADATION

No Data Available.

13 Disposal considerations

If this undiluted product is discarded as a waste, the US RCRA hazardous waste identification number is :
Not applicable.

Please be advised; however, that state and local requirements for waste disposal may be more restrictive or otherwise different from federal regulations. Consult state and local regulations regarding the proper disposal of this material.

14 Transport information

Transportation Hazard: Not Applicable
DOT: Not Regulated

DOT EMERGENCY RESPONSE GUIDE #: Not applicable
Note: Some containers may be DOT exempt, please check BOL for exact container classification
IATA: Not Regulated

IMDG: Not Regulated

15 Regulatory information

TSCA:

All components of this product are included on or are in compliance with the U.S. TSCA regulations.

CERCLA AND/OR SARA REPORTABLE QUANTITY (RQ):

No regulated constituent present at OSHA thresholds

NSF Registered and/or meets USDA (according to 1998 Guidelines):

Registration number: Not Registered

SARA SECTION 312 HAZARD CLASS:

Immediate(acute);Delayed(Chronic)

SARA SECTION 302 CHEMICALS:

No regulated constituent present at OSHA thresholds

SARA SECTION 313 CHEMICALS:

No regulated constituent present at OSHA thresholds

CALIFORNIA REGULATORY INFORMATION

**CALIFORNIA SAFE DRINKING WATER AND TOXIC
ENFORCEMENT ACT (PROPOSITION 65):**

No regulated constituents present

MICHIGAN REGULATORY INFORMATION

No regulated constituent present at OSHA thresholds

16 Other information

HMIS VII

CODE TRANSLATION

Health	2	Moderate Hazard
Fire	1	Slight Hazard
Reactivity	0	Minimal Hazard
Special	NONE	No special Hazard
(1) Protective Equipment	D	Goggles, Face Shield, Gloves, Apron

(1) refer to section 8 of MSDS for additional protective equipment recommendations.

CHANGE LOG

	EFFECTIVE DATE	REVISIONS TO SECTION:	SUPERCEDES
	-----	-----	-----
MSDS status:	24-JAN-2007		** NEW **
	08-MAR-2010	4, 8	24-JAN-2007
	03-NOV-2010	7	08-MAR-2010

Attachment 2

Certificate of Analysis

Sample of standard COA

08/10/2012

7159706 OPTISPERSE PWR6600 D3 DRUM

Characteristics	Result	Method
CLARITY	CLEAR	BD0023.1
PHYSICAL STATE	LIQUID	BD0023.1
COLORLESS YELLOW	COLORLESS	BD0023.1
COLORLESS YELLOW	YELLOW	BD0023.1

Characteristics	UofM	Specification Min Max		Result	Method
BASE#(mgKOH/gm) TO PH 2.9	MQ	71.6	81.6		BD1007.2
LVT VISC. SP2@60RPM@77°F/25°C	cps	90.0	180.0		BD0006.2
NEAT PH	pH	8.00	9.00		BD0004.1
PPM ACRYLIC ACID	PPM	0.0	499.0		QM0510.2
PPM IRON BY ICP	PPM	0.0	5.0		ATM129.4
PPM ISOPROPANOL	PPM	0.0	999.0		QM0413.1
SPECIFIC GRAVITY @77°F/25°C	SG	1.050	1.071		BD0012.1
ppm Aluminum by ICP < or =	PPM	0	10		ATM129.4
ppm Arsenic by ICP < or =	PPM	0	10		ATM129.4
ppm Bismuth < or =	PPM	0	1		ATM129.7
ppm Boron by ICP < or =	PPM	0	10		ATM129.4
ppm Chloride by IC < or =	PPM	0	10		ATM138.1
ppm Copper by ICP < or =	PPM	0	2		ATM129.4



Certificate of Analysis

Sample of standard COA

08/10/2012

7159706 OPTISPERSE PWR6600 D3 DRUM

Characteristics	UofM	Specification		Result	Method
		Min	Max		
ppm Fluoride by IC < or =	PPM	0	10		ATM138.1
ppm Lead by GFAAS < or =	PPM	0	1		ATM157.1
ppm Mercury by ICP < or =	PPM	0	10		ATM129.4
ppm Phosphorous as PO4 < or =	PPM	0	10		ATM129.4
ppm Potassium by FES < or =	PPM	0	10		ATM155.1
ppm Silica as SiO2 < or =	PPM	0	10		ATM129.4
ppm Sodium by FES < or =	PPM	0	20		ATM156.1
ppm Sulfur as SO4 < or =	PPM	0	10		ATM129.4
wt % Polymer Assay	%	9.60	10.40		QM_1037.1



Attachment 3

Dispersant Flush Application Turkey Point Unit 4



Revision 0

Final

January 28, 2013

Joe Bates

ChemStaff Inc.

jdbates@chemstaff.com

Danial Soorty

ChemStaff Inc.

Danial.soorty@chemstaff.com

Table of Contents

Introduction	2
Executive Summary.....	2
Table 1: Summary of PAA addition times and volumes through Phases 1 to 5, Cases 1 and 2 for the condensate flush evolution.....	2
Table 2 Approximate System Volumes for Phases 1 through 5.....	2
Table 3 Approximate Volumes for the Condensate Flush Phase 5, Case 1 and Case 2	3
Approach.....	3
Table 4 Description of Equation 1 Parameters	3
Assumptions.....	4
Simulations and Results	4
Case 1 – No Vacuum	4
Figure 1: Phases 1 and 2 of the condensate flush – Case 1. The removal of PAA in the phase two section of the figure is due to consumption of PAA by Iron.....	5
Figure 2 Phase 3 of the condensate flush evolution. The target concentration is reached 10 hours after the beginning of phase 3.....	6
Figure 3 Phase 4 and 5 of the condensate flush evolution. Approximately 22 hrs are required for the concentration of dispersant to drop to less than 20 ppb.	7
Figure 4 PAA concentration in Canal Dump for Case 1.....	8
Table 5: Cumulative PAA added during condensate flush evolution.....	8
Case 2 – Vacuum	8
Figure 5 Phases 1 and 2 for the condensate flush evolution for Case 2.....	9
Figure 6 Phase 3 of the condensate flush evolution for Case 2.....	10
Figure 7 Phase 4 and Phase 5 for the condensate flush evolution for Case 2.....	11
Figure 8 PAA Concentration for Canal Dump Case 2 through Phases 3, 4 and 5.....	12
Appendices.....	13
Figure 9 represents a snapshot view of phases 1 through 5 for Case 1 of the condensate flush evolution	13
Figure 10 represents a snapshot view of phases 1 through 5 for Case 2 of the condensate flush evolution	14
References	15

Introduction

Turkey point Nuclear Generating Station is a twin reactor nuclear power station owned by Florida Power & Light. It is located on a 3,300 acre site 2 miles east of Homestead, Florida. Turkey Point 3 and Turkey Point 4 have each have a gross capacity of 729 MWs powered by Westinghouse 3-loop reactors. Turkey point unit 4 is undergoing a replacement of various secondary side components. To prevent the transfer of contaminants from the secondary side components to the steam generators a condensate flush is performed in order remove as much of the contaminants as possible. One of the more significant contaminants present as a result of new secondary side components is iron. Iron is also detrimental to steam generator thermal performance through various fouling mechanisms. During the flush process an EPRI approved dispersant is used to remove loosely adhered iron from the surfaces of the new secondary side components. This helps to mitigate the effects of transferring iron from the condensate-feedwater system into the steam generators.

Executive Summary

The condensate flush program consists of 5 phases. Each phase outlines a strategy to flush a section of the condensate section. The condensate flush program is outlined in detail in the FPL document Secondary Plant Clean Up Plan, U4C27 – EPU. The approximate volumes of the condensate flush phases along with the estimated bleed rates are presented in Table 3. Table 1 summarizes the time of addition and volume of PAA added during each phase.

Table 1: Summary of PAA addition times and volumes through Phases 1 to 5, Cases 1 and 2 for the condensate flush evolution

Chem Add Times → Case No.	Volume of PAA Added (Neat as 10% solution)					Cumulative Volume of PAA added
	Phase 1 1.5 Hours	Phase 2 9 Hours	Phase 3 C1: 34 Hours C2:30 and 42 Hours	Phase 4 T=49.5 Hours	Phase 5 T=74 Hours	
Case 1	0.73	0.37	0.65	0	0	1.75
Case 2	0.73	0.37	0.62, 0.40	0	0	2.12

Table 2 Approximate System Volumes for Phases 1 through 5

Phase	Volume (Ft ³)	Volume (Gallons)
1	9700	72561
2	9700	72561
3	15000	112208
4	15000	112208
5	15000	112208

In Phase 5 the condensate and feedwater systems will be turned over using a site procedure 4-NOP-073 [1] which quickly drains a volume of water while all of the time making up to the hotwell at a flowrate of 300 gpm. The volume of water drained per evolution is dependent on whether or not there is condenser vacuum established. In either case, the drain rate is 4,150 gpm.

Table 3 Approximate Volumes for the Condensate Flush Phase 5, Case 1 and Case 2

Phase 5		System Volume Ft ³	Volume Gallons	Feed Rate gpm	Bleed Rate gpm	Dump Volume gallons (Ft ³)	Total Makeup Volume Gallons ¹
Case 1	Dump Flush (No vacuum)	15,000	112,208	300	4,150	28,784 (3,848)	450,000
Case 2	Dump Flush (Vacuum)	15,000	112,208	300	4,150	3,396 (454)	625,200

¹ Volume required to return the PAA concentration to 20 ppb.

Approach

Dispersant will be added to the system using a barrel pump or vacuum drag depending on whether vacuum is established in the condenser. In both cases however, dispersant will have to be diluted according to a 3:1 ratio due to the viscosity of neat dispersant solution. A target dispersant concentration of 1 ppm has to be maintained in order to add dispersant during the condensate flush. In order to maintain a concentration of 1 ppm in the condensate-feedwater system, a model was developed to estimate the concentration of dispersant through the flush evolution. Equation 1 was developed to model the various factors that affect dispersant concentration during the flush evolution.

$$A_2 = \left[\frac{A_1 V_1}{V_2} e^{-\lambda t} + \frac{I(100,000)}{V_2} \right] (1 - X_R) \quad (1)$$

Where:

Table 4 Description of Equation 1 Parameters

Parameter	Definition	Units
A ₂	Current Concentration	ppm
A ₁	Previous Concentration	ppm
V ₂	Current System Volume	Gallons
V ₁	Previous System Volume	gallons
$\lambda_{FB} \left[\left(\frac{\dot{V}}{V_2} \right), \dot{V} \text{ is the bleed rate} \right]$	Cleanup up constant	min ⁻¹
t	Time	Hours
X _R	Fraction of dispersant consumed ¹	-
I	Dispersant added	Gallons
Dispersant concentration in solution	100,000	ppm

¹ It is assumed that 67% of dispersant will be consumed over an 8 hour period. This is based on operating experience at Byron



In the case that dump flushes are used, an approximate average bleed rate is derived using the variables presented in Table 3. The approximate values are presented as overall bleed rate in Table 3.

The equation is then incorporated into Microsoft Excel, along with the volumes and bleed rates for each phase in the condensate flush plan as shown in Table 3.

Assumptions

1. A 0 gpm water loss during condensate flush is assumed
2. Dispersant, excluding that which is consumed by iron or drained out of the system, is not removed from the system through any other means
3. 8 hours are required for the PAA to be fully consumed by the interacting system
4. Mixing of dispersant is instantaneous
5. Dump Flushes can be approximated as an average bleed rate
6. The volume change due to addition of PAA is insignificant compared with the system volume
7. Other system manipulations such as pump swaps will not significantly impact the consumption of PAA.

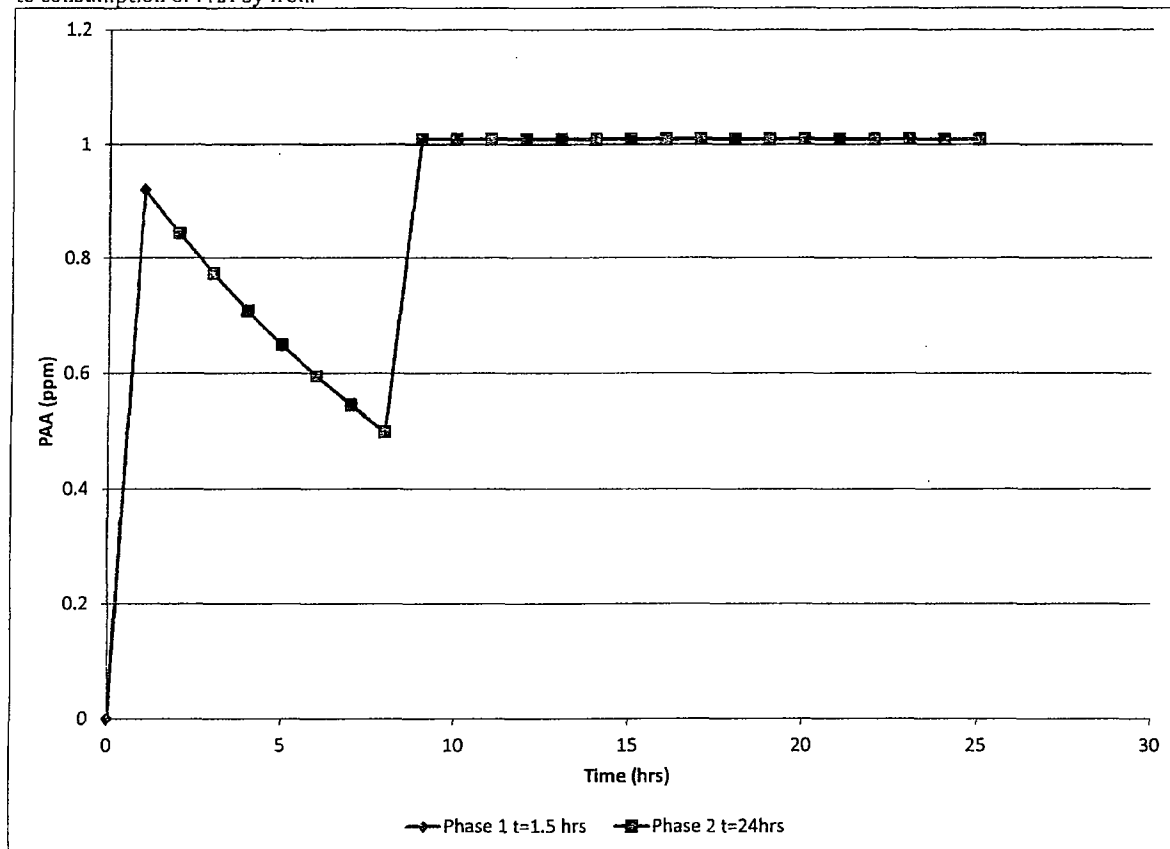
Simulations and Results

The simulation is divided into two cases, depending on whether condenser vacuum is established. The simulation that includes condenser vacuum is defined as Case 1 and the simulation where condenser vacuum is not established is defined as Case 2. Table 3 provides an outline of the distinguishing factors between the two phases. The presence of vacuum has an effect on the average bleed rate in the system, which has a subsequent effect on cleanup time. Moreover, sealing steam flowing at 40 gpm also has an effect on the dilution of PAA in the system. Consequently, in each case the system behaves differently and is presented in the following sections. Table 1 provides a summary of the volume of PAA added at each step for cases 1 and 2 for each phase of the condensate flush evolution.

Case 1 – No Vacuum

The following case represents the condensate flush without the presence of vacuum in the condenser. Phases 1 and 2 are presented in Figure 1.

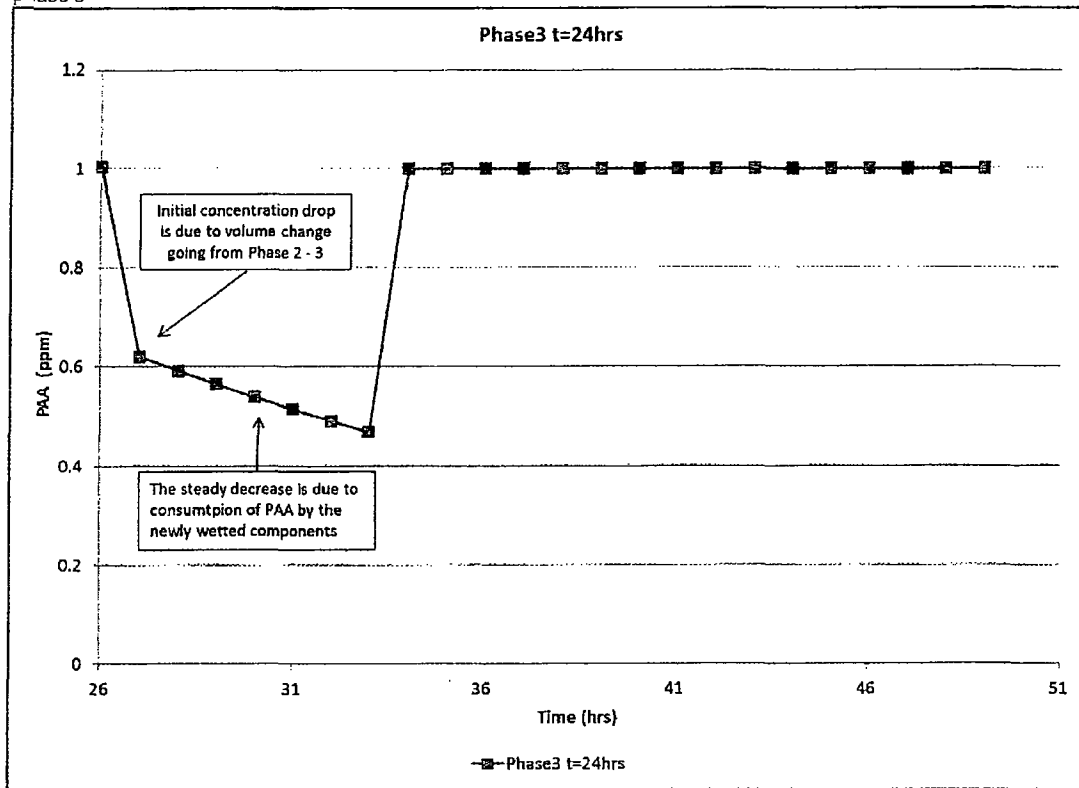
Figure 1: Phases 1 and 2 of the condensate flush – Case 1. The removal of PAA in the phase two section of the figure is due to consumption of PAA by Iron.



The duration of Phase 1 is 1.5 hours and that of Phase 2 is 24 hours. Due to the short duration of phase 1, it is assumed that a small amount of PAA is consumed. The target PAA level is 1 ppm, however due to the simultaneous consumption of PAA by the iron initially in the system, the PAA concentration does not reach 1 ppm until Phase 2.

Figure 2 presented below represents phase 3 of the condensate flush evolution.

Figure 2 Phase 3 of the condensate flush evolution. The target concentration is reached 10 hours after the beginning of phase 3



The initial concentration of PAA decreases when the condensate flush enter phase 3. This is due to the increase in volume from 9,700 ft³ to 15,000 ft³, as shown in Table 2. The newly wetted surfaces and components introduce new iron into the system which in turn increases the demand for PAA as shown by the initial and steady decrease of PAA concentration in Figure 2. It is assumed that after the second addition of PAA there is no further PAA consumption by the iron. This is a conservative assumption, and it is possible that the PAA concentration decreases when newly wetted surfaces are introduced in the system. Figure 3 represents Phase 4 and Phase 5 of the condensate flush evolution.

Figure 3 Phase 4 and 5 of the condensate flush evolution. Approximately 22 hrs are required for the concentration of dispersant to drop to less than 20 ppb.

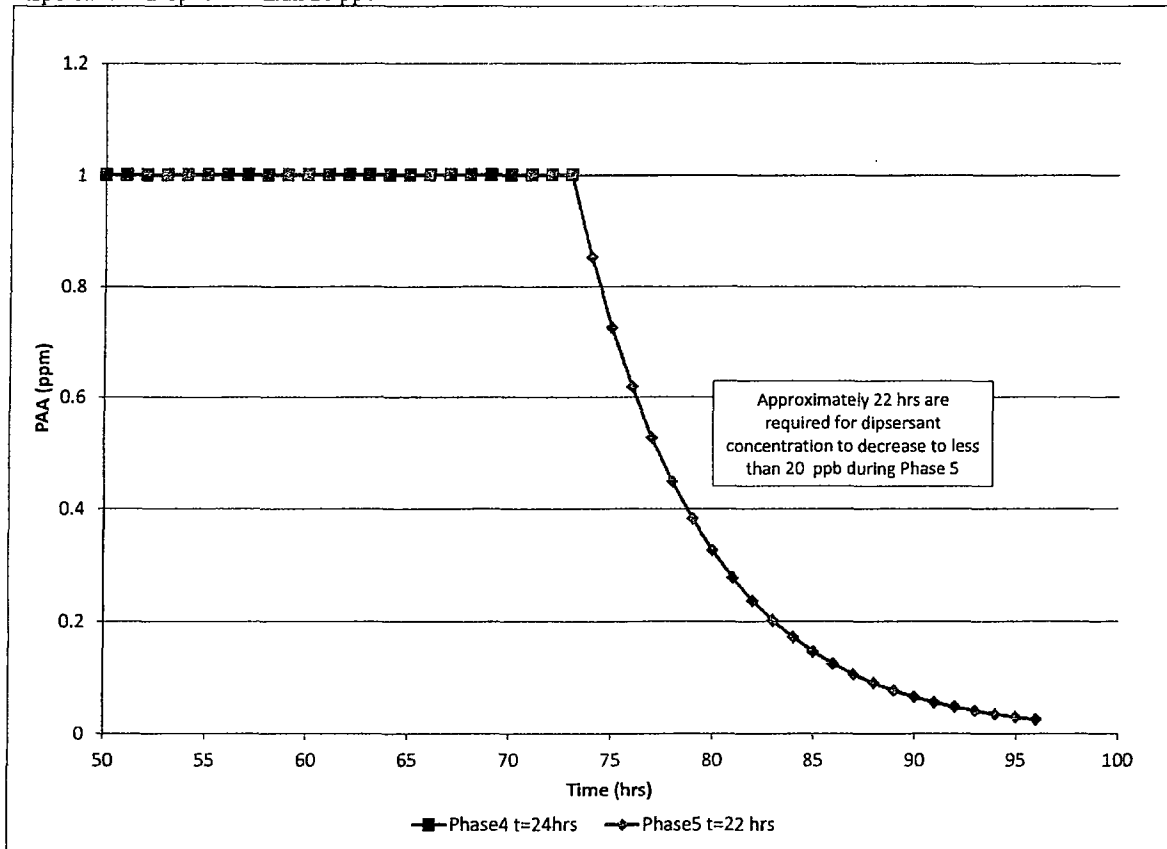
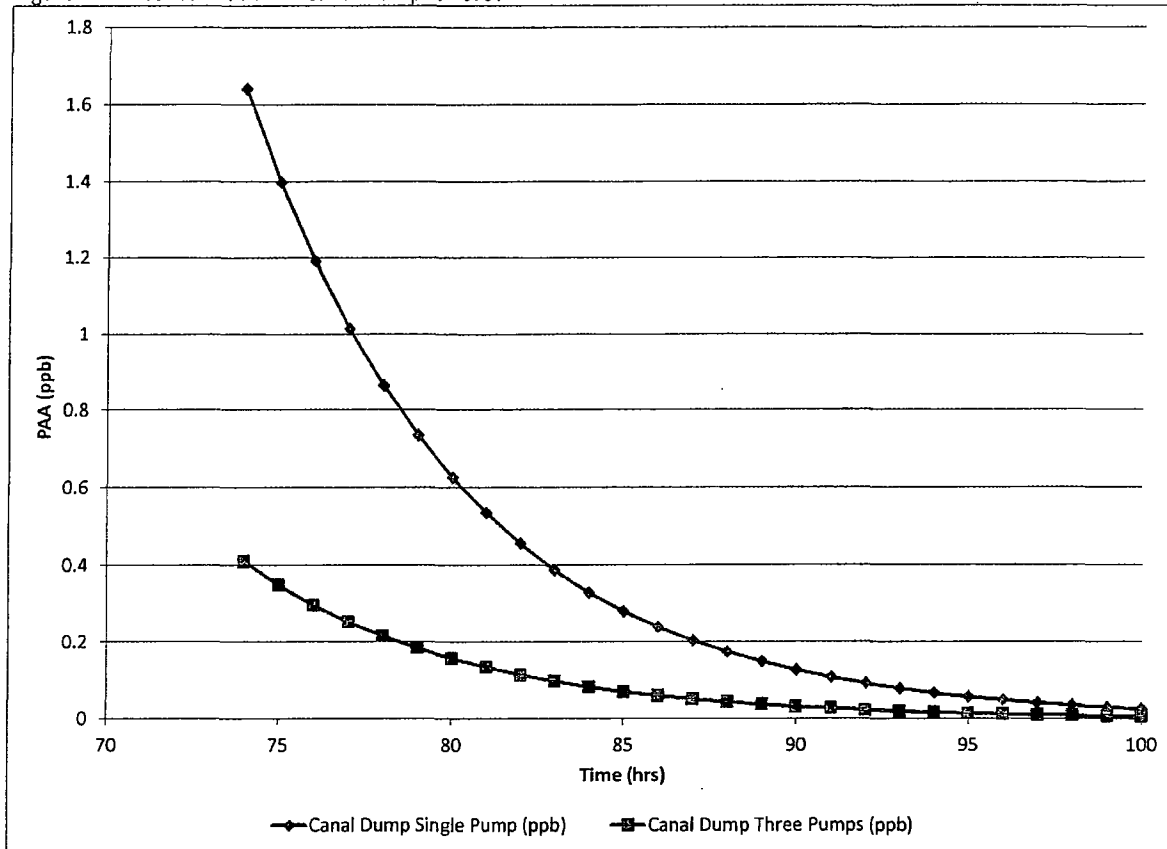


Figure 3 shows the evolution of PAA through the condensate flush system through phases 4 and 5. The concentration of PAA is assumed to be relatively constant, i.e. no consumption, in Phase 4 because there is no large change in volume. It takes approximately 22 hours to reach a less than 20 ppb concentration of PAA in the condensate system in Phase 5.

The total volume of PAA added as well as the cleanup curves are presented in Table 5: Cumulative PAA added during condensate flush evolution and Figure 4.

Figure 4 PAA concentration in Canal Dump for Case 1



The cleanup for the Canal Dump of PAA for Case 1 is presented in Figure 4 for the cases of a single pump and three pumps in operation.

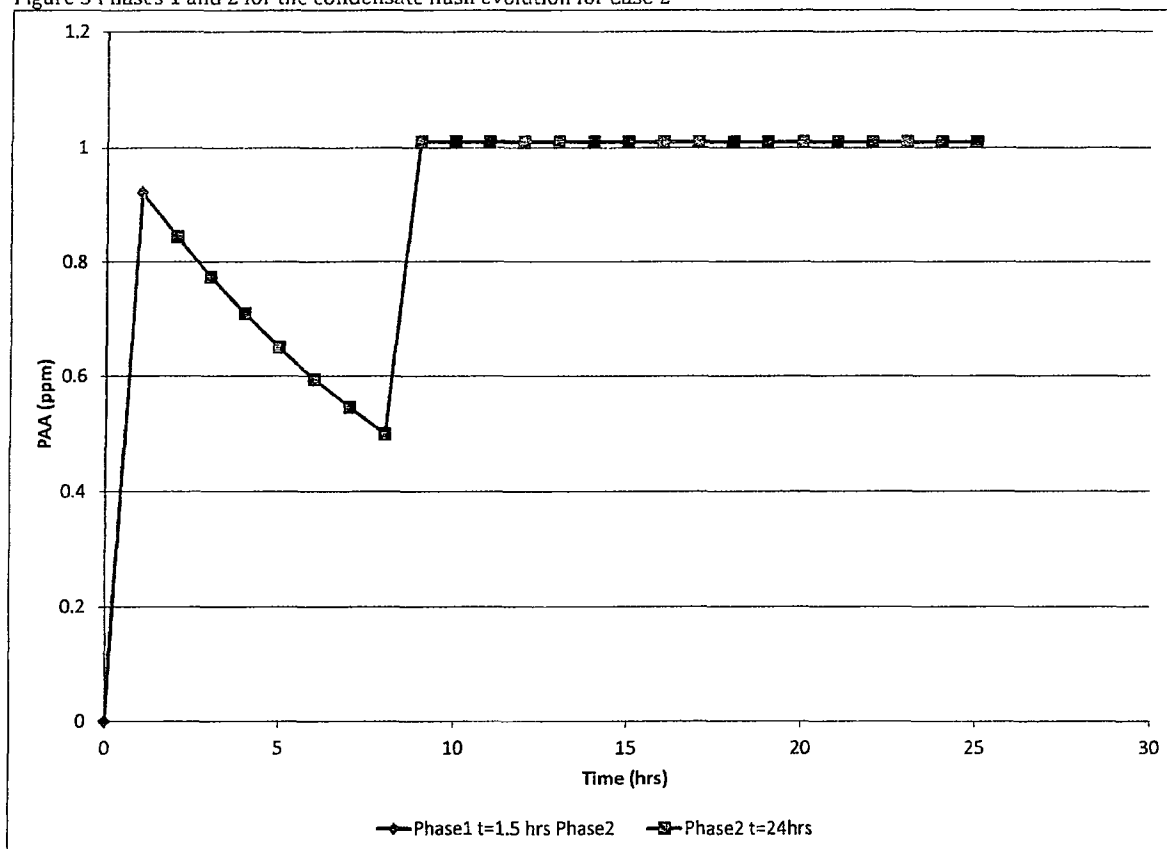
Table 5: Cumulative PAA added during condensate flush evolution

Cumulative PAA Added	Total PAA Added – Neat (Gallons)	Total PAA Added – Diluted (Gallons)
Case 1 – No Vacuum	1.75	7.0

Case 2 – Vacuum

Case 2 represents the evolution of the condensate flush with the condenser under vacuum. As shown in Table 3, there is a different average bleed rate when the system is under vacuum. Moreover, there is additional dilution occurring from the sealing steam at 40 gpm. Figure 5 represents the case for the condensate flush evolution for Phases 1 and 2.

Figure 5 Phases 1 and 2 for the condensate flush evolution for Case 2



Phases 1 and 2 for Case 1 and Case 2 are the same since the condensate has not yet been placed under vacuum.

Figure 6 Phase 3 of the condensate flush evolution for Case 2

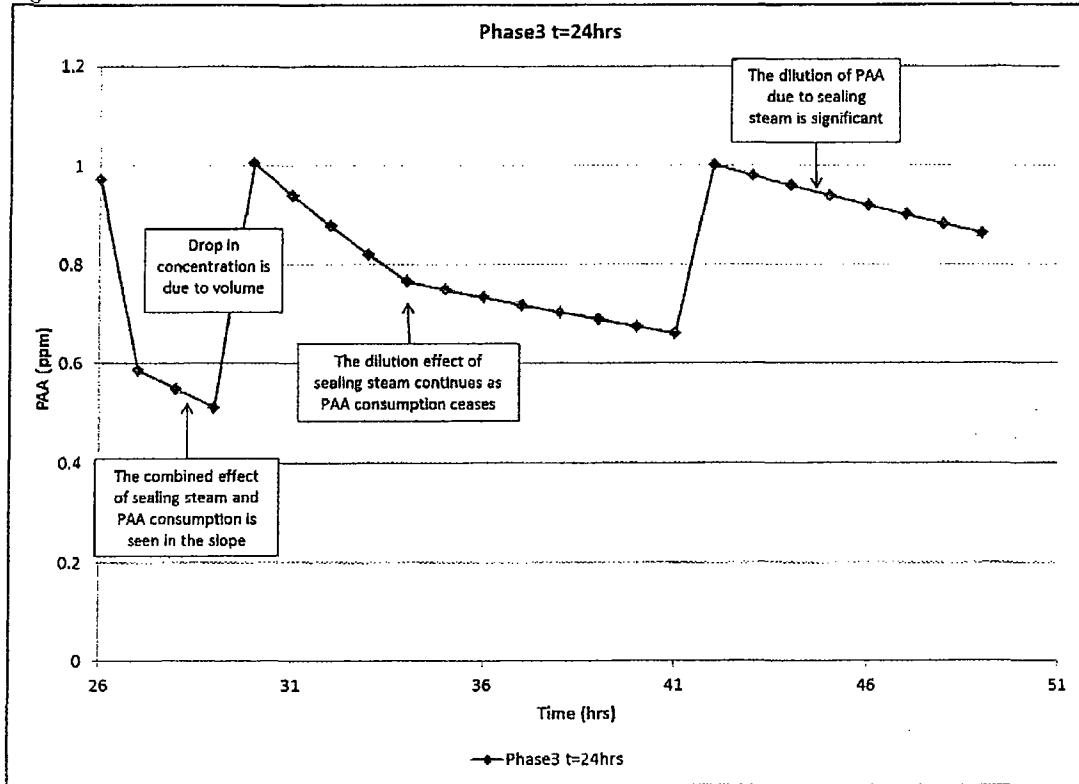


Figure 6 represents Phase 3 of the condensate flush evolution. The dilution effect of sealing steam is seen in the change in of slope around the 35 hour mark of the condensate flush evolution. The dilution effect is also prominent around the 42nd hour mark, and as a result a larger volume of PAA is required to maintain the target concentration in the system for Case 2.

Figure 7 Phase 4 and Phase 5 for the condensate flush evolution for Case 2

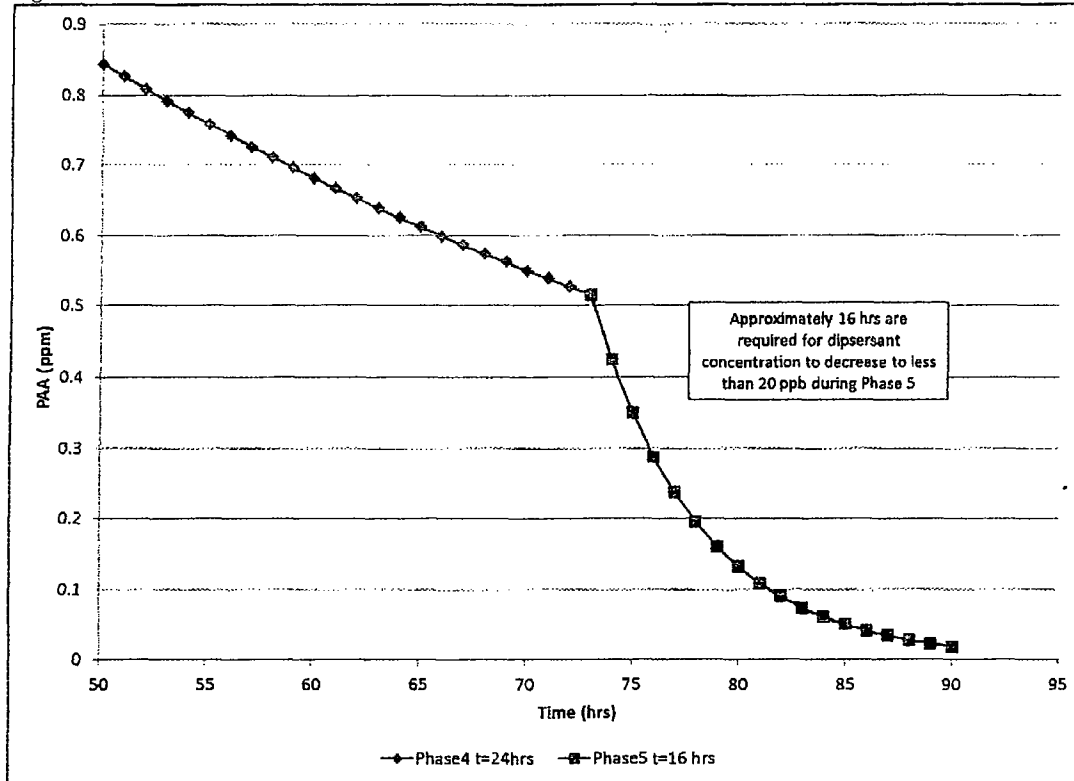


Figure 7 represents the condensate flush evolution for Phase 4 and Phase 5. The time to reach a less than 20 ppb concentration of PAA in the condensate system is 16 hours for Case 2 compared with 22 hours for Case 1. This is due to the additional dilution due to the sealing steam.

Figure 8 PAA Concentration for Canal Dump Case 2 through Phases 3, 4 and 5

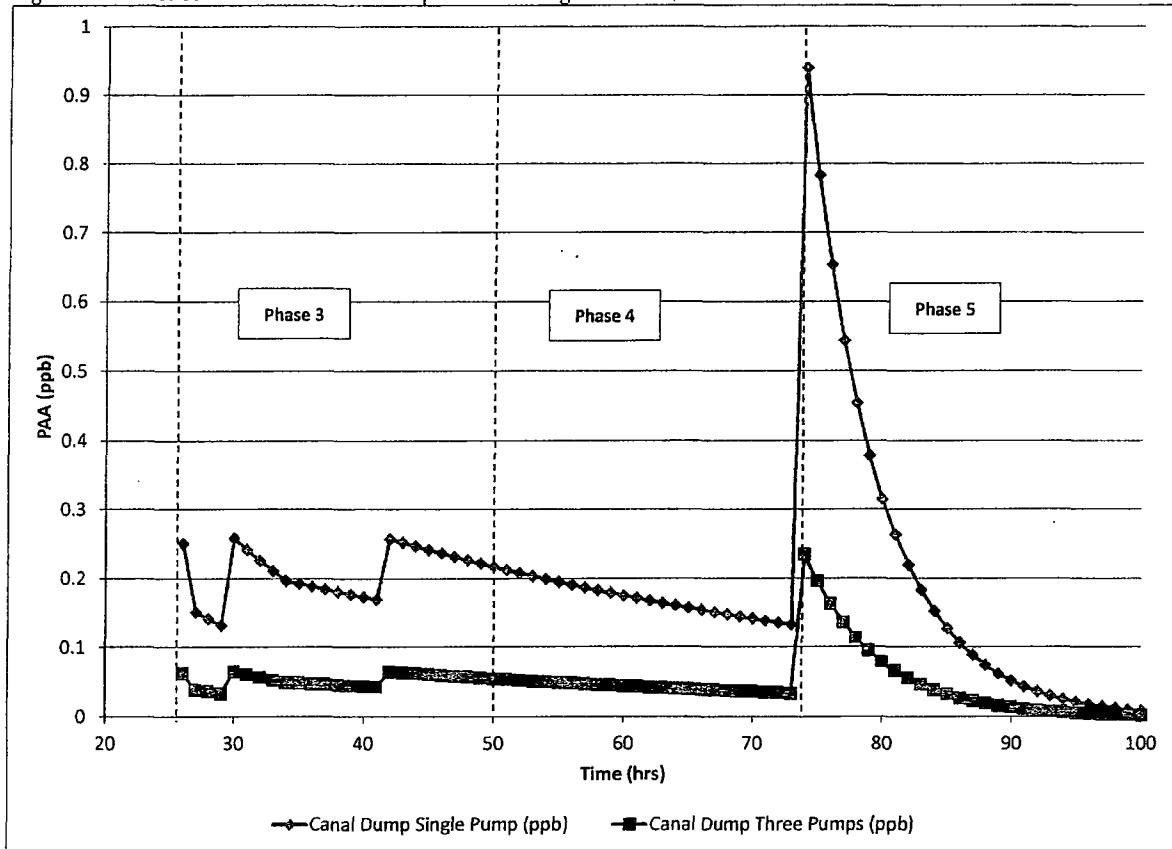


Figure 8 represents the single and three pump cases for the canal dump of PAA in Case 2, through phases 3, 4 and 5. The canal dump cleanup up is faster due to the effect of the sealing steam.

Appendices

Figure 9 represents a snapshot view of phases 1 through 5 for Case 1 of the condensate flush evolution

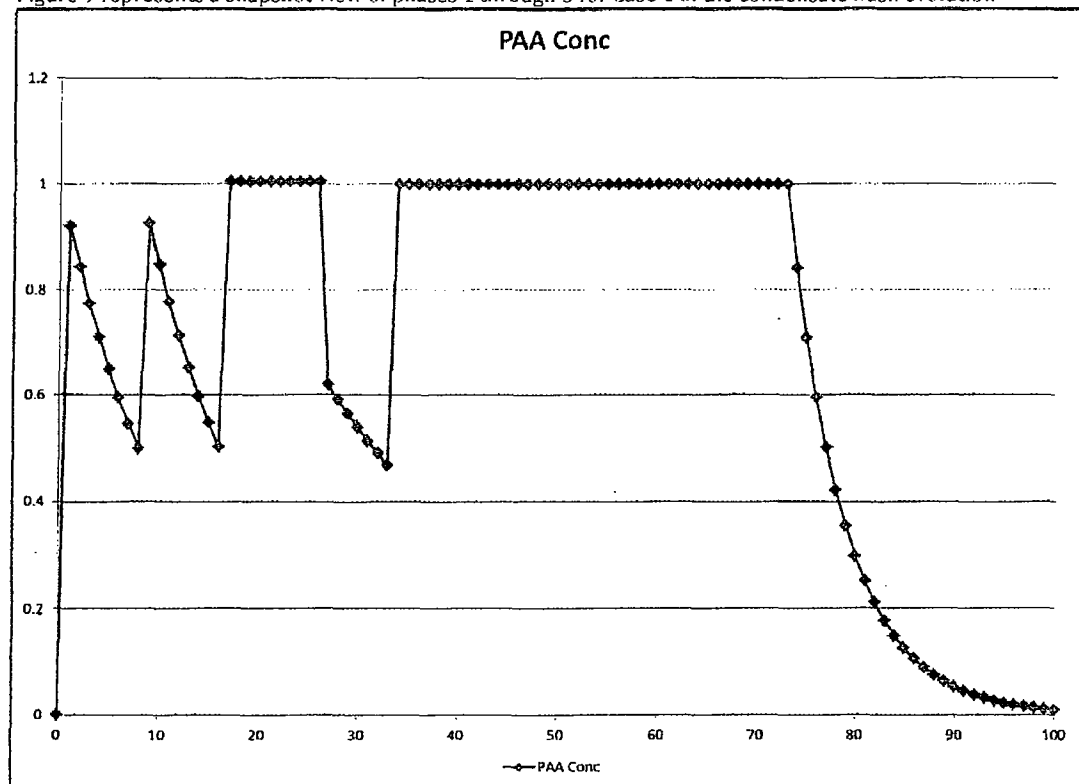
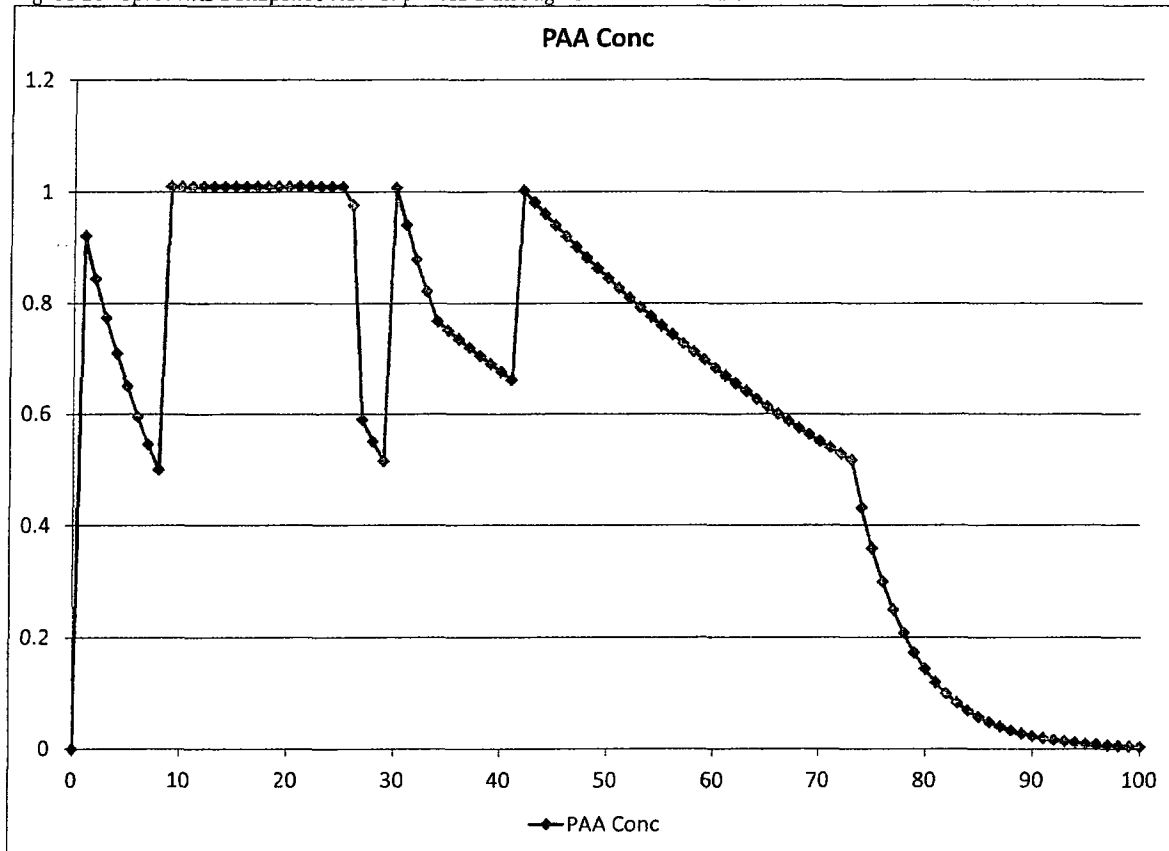
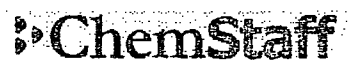


Figure 10 represents a snapshot view of phases 1 through 5 for Case 2 of the condensate flush evolution





References

1. EPU-PTN-13-0027, "Turkey Point Units 3 & 4 Extended Power Uprate Project Inputs to Complete the PAA Modeling", January 17, 2012.

Attachment 4



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PESTICIDES AND TOXIC
SUBSTANCES

2-1-91

MEMORANDUM

SUBJECT: Environmental Concerns of Polymers *M. Zeeman*
FROM: J. Vincent Nabholz, Ph.D. and Maurice G. Zeeman, Ph.D.
Senior Scientist and Chief, respectively
Environmental Effects Branch
Health and Environmental
Review Division (TS-796)
TO: Mary E. Cushmac
New Chemicals Branch
Chemical Control Division (TS-794)

As per your request, this is the current status of the environmental concerns of polymers (MW > 1000). Vince Nabholz, EEB, prepared this response.

ENVIRONMENTAL CONCERNS OF POLYMERS

All polymers are divided into four classes depending on the type of electronic charge of the polymer: nonionic (neutral); anionic (negative charge); cationic (positive charge); and amphoteric (mixture of positive and negative charges on same molecule) polymers.

I. POLYMERS WITH MW < 1000.

Polymers with MW < 1000 and some water solubility may be of concern because of their potential to act like polymers whose MW > 1000 and of their potential to be absorbed through biological membranes and cause systemic effects.

A. Polynonionic (neutral) polymers.

Small neutral polymers are generally assessed based on the type of functional group, e.g., aniline, phenol, alcohol, epoxide, etc. Polynonionic polymers are evaluated on the basis of their octanol/water partition coefficients (K_{ow} or P), melting point (mp), water solubility (SH_2O), and predicted toxicity to aquatic

organisms using structure activity relationships (SAR, e.g., quantitative structure activity relationships [QSAR]) just as you would assess a monomer with the same functional group. For example, polyphenols are assessed as you would assess a phenolic monomer using the phenol SARs (Clements 1988).

B. Polyanionic (negatively charged) polymers.

Small polyanionic polymers are assessed by using the nearest analog method. The chemical structure of the anionic group(s), e.g., carboxylic acid, phosphoric acid, sulfonic acid, is compared to analogous larger polymers with significant amounts of low molecular weight (LMW) components or polyanionic monomers (e.g., EDTA) for which there is environmental test data. In general, the concerns for these small polymers are the same as for the large polymers whose MW > 1000 with the additional concern for the potential absorption and subsequent systemic toxicity.

C. Polycationic (positive charged) polymers.

Polycationic polymers are assessed by using either the SARs for polycationic polymers (Clements 1988), the aliphatic amine SARs, the SARs for quaternary ammonium surfactants (Clements 1988), or the generic review of small quaternary ammonium (non-surfactant) compounds.

D. Polyamphoteric (polymers containing cationic and anionic charges within the same molecule) polymers.

Small polyamphoteric polymers with equal numbers of cationic charges and anionic charges, or with greater cations than anions are treated as a polycationic compound. The toxicity of the polycationic portion of the compound is reduced based on the number of anionic charges. When there are greater numbers of anions than cations, the compound is treated as a polyanionic polymer.

II. POLYMERS WITH MW > 1000.

Hazardous polymers with MW > 1000 are expected to be water soluble (or self-dispersing), are not expected to be absorbed through biological membranes, and are expected to assert their toxicity by affecting the outer membranes of aquatic organisms or the near environment of the organism (e.g., over-chelation of nutrient elements). Insoluble polymers are not expected to be toxic unless they are ground up into fine particles. The toxicity of finely ground particles is due to indirect (physical) toxicity (e.g., the clogging of respiratory organs such as gills) and only occurs at high concentrations, i.e., acute toxicity

values of greater than 1000.0 mg/L and chronic toxicity values of greater than 50.0 mg/L. The toxicity of finely ground insoluble polymers does not depend upon the chemical structure of the polymer.

A. Nonionic (neutral) polymers.

Polynonionic polymers which have MW > 1000 are of low concern.

B. Anionic (negatively charged) polymers.

Polyanionic polymers which have MW > 1000 and which are water soluble (miscible or self-dispersing) are of concern for aquatic toxicity. Polyanionic polymers are divided into three subclasses: poly(carboxylic acids), poly(aromatic sulfonates), and poly(aliphatic sulfonates).

1. Poly(carboxylic acids) are of concern only for their toxicity to green algae. Toxicity to algae as defined by the 96-h EC50 for growth inhibition, is moderate with toxicity values ranging from 1 to 100 mg/L (ppm). It appears that the mode of toxic action of these poly(carboxylic acids) is over-chelation of nutrient elements needed by algae for growth. When enough calcium (as divalent cation) is added to a polymer to satisfy its anionic charges, toxicity to algae is mitigated. It is unknown if calcium (as calcium carbonate in water with hardness of 100 to 150 mg/L as CaCO₃) added to algal growth medium will also mitigate toxicity to an equal degree.

a. Structural requirements. Poly(acrylic acid) is moderately toxic to green algae and appears to be the most potent form of poly(carboxylic acid) in its ability to chelate nutrient elements. Its chemical structure is --[CC(COOH)]-- where you have a carboxylic acid on every other (or alternating) carbon(s) in the polymer backbone. The carboxylic acids are paired and equal distance from the polymer backbone. Test data for poly(maleic acid) indicated low toxicity to algae, i.e., 96-h EC50 = 560.0 mg/L, and, thus, a weak ability to chelate nutrient elements. In this polymer, there is a carboxylic acid on every carbon of the polymer backbone, i.e., --[C(COOH)C(COOH)]--. Additional FMN test data have suggested that (1) when the carboxylic acids are further separated, e.g., a carboxylic acid on every fifth carbon of the polymer backbone, or (2) when the carboxylic acids are different distances from the polymer backbone, the polymer's ability to chelate nutrient elements is reduced. The test data to support these last two conclusions are weak. In summary, the most potent structure for poly(carboxylic acid) polymers is paired acids which are equal distant from the polymer backbone and which have one acid on alternating carbons.

b. Mitigation of toxicity. The toxicity of poly(acrylic acid) polymers has been shown to be mitigated 13 times by the addition of one equivalent of Ca to the polymer before testing. PMN test data have indicated that the 96-h EC50 increased from 37.4 mg/L to 500.0 mg/L if you chelate the polymer with divalent ions before exposure to algae. This indirect toxicity to algae via over-chelation of nutrient elements may be a laboratory artifact because (1) many poly(carboxylic acid) polymers are used as scale inhibitors and are released to the natural environment chelated with Ca and Mg, (2) these polymers are initially tested as the Na or K salt, and (3) the OTS Environmental Test Guideline recommends a growth medium which has a hardness of only about 15.0 mg/L as CaCO₃. This represents very soft water and the average hardness of freshwater in the United States is about 120.0 mg/L. In those cases where the polymer is not used as a scale inhibitor and is released to the environment as the Na or K salt, the hardness of the receiving waters (i.e., 120.0 to 150.0 mg/L) may cause a substantial mitigation of the toxicity relative to the toxicity observed in the standard algal toxicity test. However, there are not sufficient test data to demonstrate the amount of mitigation due to moderately hard growth medium.

c. Testing scheme. (1) Polymers used as scale inhibitors and released to the environment chelated with calcium and magnesium ions should be tested three times with freshwater green algae: (a) test chemical as is, (b) test chemical with an equivalent of Ca⁺⁺ added to the stock solution, and (c) test chemical as is but tested with modified algal test/growth medium. Calcium alone or Ca and Mg is added to attain a measured hardness of about 150.0 mg/L as CaCO₃. If Ca and Mg are added together, then add Ca and Mg in the ratio of 2 Ca to every Mg. Test results from the test with an equivalent of Ca added to the polymers will be used to assess releases from use. Test results with the polymer as the Na or K salt will be used to assess releases from manufacturing and processing. All stock solutions should be adjusted to pH 7 before testing because PMN test data have shown that, if the polymer is tested as the acid or with excess acid, the toxicity from the acid was greater than the toxicity of the polymer via over-chelation. (2) Polymers not used as scale inhibitors and are released to the environment as produced (generally as the Na and K salts) should be tested twice with green algae: (a) the polymer as is, and (b) the polymer with modified algal test/growth medium.

2. Poly(aromatic sulfonates). a. Polymers showing toxicity. Poly(aromatic sulfonate) polymers with MW greater than 1000 may be of moderate concern for acute toxicity towards fish and green algae. Polymers in this class have the following characteristic monomers: sulfonated phenols, sulfonated cresols, sulfonated diphenolsulfones, sulfonated diphenyloxides, and sulfonated diphenylsulfones. This concern is based on two facts.

The first is test data for 8 PMN polymers which indicated acute toxicity values of about 5.0 mg/L for fish (as a 96-h LC50) and 20.0 mg/L for algae (as a 96-h EC50). This evidence is weak because while these polymers have average number MWs equal to or greater than 1000, they have substantial amounts of low molecular weight (LMW) components: > 10% < 500 and > 25% < 1000. The observed toxicity could have been due to the LMW components. However, the second fact is that the Agency has recently received data for a PMN polymer which had a MW = 12,200, <0.1% <500, and <0.1% <1000, contained a carboxylic acid substituted diphenolsulfone, and was moderately toxic to aquatic organisms, i.e., fish 96-h LC50 = 72.0 mg/L, daphnid 48-h LC50 = 86.0 mg/L, and green algal 96-h EC50 = 40.0 mg/L (hardness [H] of medium = 18.0 mg/L as CaCO₃). This polymer was tested three additional times with harder growth medium. There was no significant mitigation of the toxicity, i.e., H = 46 mg/L, EC50 = 24.0 mg/L, H = 152 mg/L, EC50 = 20 mg/L, and H = 160 mg/L, EC50 = 47.0 mg/L. The only common monomer between these two sets of polymers was the acid substituted diphenolsulfone.

b. Polymers showing low toxicity. Poly(aromatic sulfonate) polymers which have been shown to have low toxicity (i.e., acute toxicity values greater than 100.0 mg/L) or are highly suspected of having low toxicity are composed of the following monomers: benzene sulfonates and sulfonated naphthalene.

3. Poly(aliphatic sulfonates). There are not enough test data for these polymers to draw any firm conclusions about their toxicity. However, it is suspected that if these polymers show toxicity to aquatic organisms it will be to algae as was observed for the poly(carboxylic acid) polymers.

c. Polycationic (positively charged) polymers.

Polycationic polymers include polyamines (primary amines, secondary amines, and tertiary amines); quaternary amines; polysulfoniums; and polyphosphoniums. Polymers of concern have MWs >1000 and are water soluble (miscible or self-dispersing). Polymers based on polyglucosamines (i.e., chitosan) are much less toxic than predicted and are no longer of concern.

1. Toxicity. Aquatic toxicity in clean water (i.e., total organic carbon [TOC] < 2 mg/L) increases exponentially with increasing cationic charge density, i.e., protonated and/or quaternarized-N, S or P. An SAR for polycationic polymers has been published by Clements (1988). Charge density is measured as per cent amine-N for nitrogen-based polymers; equivalent weight of N, S, or P; or # cations/1000 MW. Toxicity to aquatic organisms increases exponentially until about 2.5 cations/1000 MW (or 3.5% amine-nitrogen or an equivalent weight = 400), thereafter, toxicity becomes asymptotic. Acute toxicity values

to fish and daphnids (i.e., aquatic invertebrates) are > 100 mg/L [i.e., low concern] at < 0.2 cations/1000 MW (or equivalent weight >5000 or <0.3% amine-nitrogen); 100 to 1 mg/L [i.e., moderate concern] at charge densities of >0.2 to 1.6 cations/1000 MW (or equivalent weights between 5000 and 625, or percent amine-nitrogen between 0.3 and 2.2); and < 1 mg/L [i.e., high concern] at > 1.6 cations/1000 MW (or equivalent weights < 625 or percent amine-nitrogen > 2.3). Green algae are about 6 times more sensitive than fish (i.e., algal 96-h EC50 versus fish 96-h LC50). The mode of toxic action for these polymers is surface active (i.e., they react with biological membranes), however, when MW falls below 1000, some systemic toxicity may also occur.

2. Mitigation of toxicity. The aquatic toxicity of these polymers with MW > 1000, < 10% <500, and < 25% <1000 is highly mitigated by the presence of dissolved organic carbon (DOC) in water. For polymers with charge densities => 2.4 cations/1000 MW (or equivalent weight < 400 or > 3.3% amine-nitrogen), the acute toxicity to fish is reduced about 94 times when the measured TOC in water is 10 mg/L as the result of adding humic acid to dilution water (i.e., TOC = 10 mg/L is equivalent to 27.6 mg/L humic acid, sodium salt; CASRN [1415-93-6]; Aldrich H1,675-2; Merck Index 10,4649). This mitigation factor of 94 is based on the results of testing 8 polymers.

The toxicity of polymers with MW > 1000 and significant amounts of LMW material, i.e., > 10% < 500 and > 25% < 1000 is mitigated less by dissolved organic matter in the water column. Two polymers with significant amounts of LMW material (i.e., one with MW = 1000, 23.3% <500, and 32.3% <1000; and another with MW = 1030, 12% <500, and 38% <1000) had mitigation factors of only 26 and 21, respectively.

The aquatic toxicity of polymers with charge densities => 2.4 cations/1000 MW (or equivalent weights <400 or >3.3% amine-nitrogen) are now of low concern for aquatic organisms living in the water column of the aquatic environment because of the predicted low risk.

There is one known exception to the mitigation/low bioavailability scenario for these polymers. When these polymers are formulated with excess acid, e.g., 20% excess acid more than you need to protonate all of the amines in a polymer; and the product pH is about 2, these polymers will fail to flocculate DOC in the water column and DOC does not appear to mitigate the acute toxicity to fish.

3. Partitioning to sediments. Many polycationic polymers are designed to react with DOC in the water column to form an insoluble flocculent. This flocculent eventually settles on sediments and accumulates in sediment. Sediment toxicity testing

with species which ingest sediment has shown that polycationic polymers with charge densities of \Rightarrow 3.0 cations/1000 MW (or \Rightarrow 3.0 cations/1000 MW or an equivalent weight \leq 333.0) are not bioavailable to cause any toxicity and are thus of low concern in sediments (Rogers and Witt (1989)).

4. Selection of humic acid for mitigation testing. Humic acid was selected as the representative dissolved organic carbon (DOC) based on research done by Cary et al (1987). Cary et al measured the mitigation of 4 suspended solids and five dissolved organic carbon (DOC) compounds on the acute toxicity of four cationic polyelectrolytes to freshwater fish and aquatic invertebrates. Humic acid was about average in its ability to mitigate toxicity. Analysis of Table 4 in Cary et al indicated that the mitigation factors (MF) for humic acid were closest to the mean MF for all of the DOCs tested. The mean MF factor was calculated for each of the polymer/species combinations. The MF of each DOC was compared to the mean MF and the absolute value of the difference was averaged for that DOC. Humic acid had the lowest average difference or, in other words, the MFs for humic acid were closest to the mean MF for each polymer/species combination, i.e., lignin > tannic acid > fulvic acid > lignosite > humic acid. In addition, humic acid is easily available from chemical supply companies.

5. Selection of 10 mg TOC/L to set the mitigation factor.

Ten mg TOC/L has been used in Agency hazard and risk assessments for three reasons: (a) concentrations of humic acid in natural waters are rarely measured, (b) the average measured amount of TOC in natural freshwater of the US is about 6.79 mg TOC/L (Lynch 1987), and (c) 10 mg TOC/L is a round number close to 7 which errs on the side of safety. Lynch (1987) analyzed the EPA Office of Water's STORET Data Base for measured amounts of TOC in US waters. Lynch found 67,994 measurements of TOC taken from 1977 through 1987 from all over the US (i.e., 19 of 23 major river basins in the US). These TOC measurements were lognormally distributed and skewed toward the larger amounts of TOC. The geometric mean of these data was 6.79 mg TOC/L. Since the Agency does generic risk assessments for most chemicals, at least the first time they are assessed, it was decided to use the average amount of TOC in natural waters as the benchmark amount of dissolved organic carbon.

6. Testing Scheme. a. The base set of environmental toxicity tests are done in clean dilution water. The base set of environmental toxicity tests include: (1) the fish acute toxicity test, the daphnid acute toxicity test, and the green algal toxicity test. All of the above tests will be done with the static method and will be based on nominal concentrations corrected to 100% active ingredients. Clean dilution water is defined as water with < 2 mg TOC/L.

b. The fish acute toxicity test will be done at least two more times with different concentrations of humic acid (HA) dissolved in the dilution water (CFR §795.115): the first test will be done with 20 mg HA/L dissolved in the dilution water. If the humic acid and the cationic chemical forms a flocculent, precipitate, or a viscous mixture which significantly interferes with the behavior of the fish or causes physical toxicity (e.g., clogging of gills), then the concentration of humic acid will be reduced (e.g., to 15 mg HA/L) until physical toxicity is not significant; the second test will be done with a humic acid concentration which is lower than the first, e.g., if the first test is done with 20 mg/L humic acid then the second test will be done with 10 mg HA/L.

c. Total Organic Carbon (TOC) determinations need to be done for the clean dilution water and for each concentration of humic acid; three TOC determinations for the clean dilution water and three determinations for each humic acid control.

d. If humic acid reduces the toxicity significantly, i.e., toxicity is substantially reduced in the presence of 10 mg TOC/L and the risk to water column organisms has been eliminated, then the only further testing will be sediment toxicity testing.

e. Sediment toxicity testing may include (1) tadpoles gavaged with contaminated sediment for 30 days (CFR §795.145), (2) tadpoles exposed to contaminated sediments in same tank for 30 days (CFR §795.145), or (3) adult daphnids exposed to contaminated sediments in same tank for 30 days (CFR §795.135).

f. If humic acid does not reduce toxicity, and there is still a significant risk to water column organisms in the presence of 10 mg TOC/L, then chronic toxicity testing for fish and aquatic invertebrates will be required.

g. The chronic toxicity test for fish (CFR §797.1600) is the fish early life stage toxicity test using clean dilution water, the flow-through method and nominal concentrations based on 100% ai. The chronic toxicity test for aquatic invertebrates (CFR §797.1350) is the daphnid partial life cycle toxicity test using clean dilution water, flow-through method, and nominal concentrations based on 100% ai.

D. Polyamphoteric (polymers containing cationic and anionic charges within the same molecule) polymers.

Polyamphoteric polymers with equal numbers of cationic charges and anionic charges or with greater cations than anions are treated as a polycationic polymer. The toxicity of the polycationic polymer portion of the polymer is reduced based on the number of anionic charges. When there are greater numbers of anions than cations, the polymer is treated as a polyanionic polymer.

III. REFERENCES.

Cary, G A, McMahon, J A, and Kuc, W J. 1987. The effect of suspended solids and naturally occurring dissolved organics in reducing the acute toxicities of cationic polyelectrolytes to aquatic organisms. *Environmental Toxicology and Chemistry* 6:469-474.

Clements, R G (editor). 1988. Estimating toxicity of industrial chemicals to aquatic organisms using structure activity relationships. Washington, DC: Environmental Effects Branch, Health and Environmental Review Division (TS-796), Office to Toxic Substances, United States Environmental Protection Agency. EPA-560-6-88-001. Available from NTIS, Springfield, Virginia 22161, PB89-117592.

Lynch D G. 1987. Summary of STORET data on dissolved organic carbon (DOC) levels in surface waters. Washington, DC: Exposure Assessment Branch, Exposure Evaluation Division (TS-798), Office of Toxic Substances, United States Environmental Protection Agency. Memorandum.

Rogers, J H, Jr. and Witt, W T. 1989. Effects of sediments flocculated with cationic polyelectrolytes when fed upon by Daphnia magna. Denton, TX: Department of Biological Sciences, University of North Texas. Available from SOCMA, 1330 Connecticut Avenue, NW, Washington, DC 20036. Unpublished manuscript.

Attachment 5

OptiSpense* PWR6600

Dispersant for Secondary Side of PWR Nuclear Steam Generators

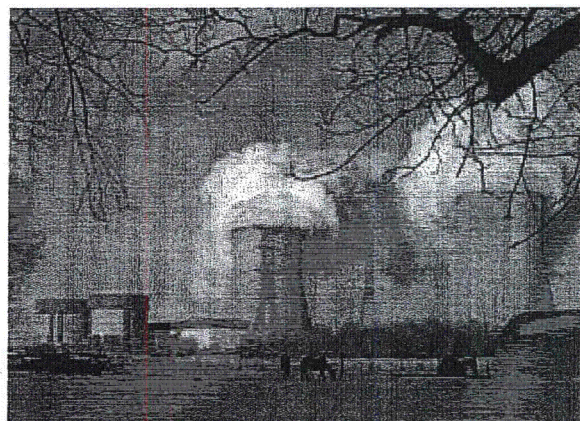
OptiSpense* PWR6600 is designed to:

- Reduce the accumulation of iron oxide corrosion products on the tube and other internal surfaces of Pressurized Water Reactor (PWR) secondary cycle steam generators
- Enable operating cost savings due to extension or deferral of off-line cleaning procedures required to periodically remove generator corrosion product inventory
- Improve the long-term reliability of PWR steam generators by reducing the potential for thermally-activated corrosion due to concentration of corrosive species under metal oxide deposits
- Lower the potential for long-term losses in steam generator thermal performance due to excessive accumulation of metal oxide deposits on tube surfaces

Description and Use

OptiSpense PWR6600 is a patented, high-performance polymeric dispersant designed to minimize iron corrosion product accumulation and fouling in the secondary cycle steam generators of recirculating, pressurized water reactors (PWRs). This product has been synthesized and formulated to meet the stringent specifications and purity requirements required by the nuclear industry, and to provide optimum activity for control of iron oxide fouling on steam generator tubes and internal surfaces in the secondary side of recirculating PWRs.

The accumulation of corrosion products, which consist primarily of iron oxide, can negatively impact the efficiency, reliability and cost of operation and maintenance in the secondary side steam generators in recirculating PWRs.



Iron and other metal oxide corrosion products deposit preferentially on boiling heat transfer surfaces (e.g., generator tubes), and their accumulation can over time reduce the thermal efficiency of the steam generator. Corrosion product deposits can also interfere with efficient operation of the generators by creating thermal-hydraulic instabilities through the blockage of tube supports.

In addition, accumulations of corrosion products can result in a corrosive condition in occluded areas beneath deposits on tubes and in the crevices formed by tube-to-tube support plates due to the concentration of species aggressive to the generator tube and support plate metallurgy.

OptiSpense PWR6600 has undergone extensive research testing, as well as field evaluations in commercial, recirculating PWR steam generators under an EPRI-managed qualification program.



Find a contact near you by visiting www.ge.com/water and clicking on "Contact Us".

* Trademark of General Electric Company; may be registered in one or more countries.

©2009, General Electric Company. All rights reserved.

Typical Applications

OptiSpense PWR6600 is designed for addition to the feedwater of secondary cycle recirculating PWR steam generators to control iron oxide accumulation in the generator, and to maximize oxide removal via the blowdown.

Treatment and Feeding Requirements

Detailed dispersant application guidelines and implementation procedures have been developed by EPRI, and should be reviewed in detail by plant chemistry and operations personnel who are planning to implement the application of OptiSpense PWR6600 for iron oxide control in their secondary side steam generators.

Your GE Water and Process Technologies representative is available to consult and assist you in design and implementation of an OptiSpense PWR6600 feed system.

Evaluation

The principal method of efficacy evaluation is the determination of iron rejection rates from the secondary steam generators both with and without use of OptiSpense PWR6600.

Safety Precautions

A Material Safety Data Sheet (MSDS) containing physical properties data and detailed safety information for this product is available by contacting your GE representative.

A Certificate-Of-Analysis (COA) detailing the required product purity specifications, and actual batch analysis, will be provided with each product delivery.