State of California
Department of Transportation
Division of New Technology,
Materials and Research

THE TOXICITIES OF SELECTED BRIDGE PAINTING MATERIALS AND GUIDELINES FOR BRIDGE PAINTING PROJECTS

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16. ABSTRACT

The effects of bridge painting operations on aquatic ecosystems were studied. Bioassays using *Daphnia magna, Physa gyrina, Selenastrum capricornutum,* fathead minnows, and rainbow trout were performed. The results indicate that both lead pigmented and paints pigmented with zinc compounds can cause toxicity. Biocides and cleaning detergent tested were highly toxic. A set of guidelines was developed to assist highway workers in determining and mitigating the impacts of bridge painting projects on the aquatic environment. The aquatic environment is broadly defined to include all beneficial uses of water and the habitat created by the water. In the guidelines, the aquatic setting is first determined, then the nature of the project is established. From the aquatic setting and nature of the project, the Area of Potential Environmental Impact and the impacts of the project are determined. Finally, mitigation is discussed.

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CONVERSION FACTORS

English to Metric System (SI) of Measurement

Quality	English Unit	Multiply By	To Get Metric Equivalent
Length	inches (in) or (")	25.40	millimetres (mm)
		.02540	metres (m)
	feet (ft) or (')	.3048	metres (m)
	miles (mi)	1.609	kilometres (km)
Area	square inches (in^2)	6.432×10^{-4}	square metres (m^2)
	square feet (ft^2)	.09290	square metres (m^2)
	acres	.4047	hectares (ha)
Volume	gallons (gal)	3.785	litre (l)
	cubic feet (ft^3)	.02832	cubic metres (m^3)
	cubic yards (yd^3)	.7646	cubic metres (m^3)
Volume/Time (Flow)	cubic feet per second (ft^3/s)	28.317	litres per second (l/s)
	gallons per minute (gal/min)	.06309	litres per second (l/s)
Mass	pounds (lb)	.4536	kilograms (kg)
Velocity	miles per hour (mph)	.4470	metres per second (m/s)
	feet per second (fps)	.3048	metres per second (m/s)
Acceleration	feet per second squared (ft/s^2)	.3048	metres per second squared (m/s^2)
	acceleration due to force of gravity (G)	9.807	metres per second squared (m/s^2)
Density	(lb/ft^3)	16.02	kilograms per cubic metre (kg/m^3)
Force	pounds (lb)	4.448	newtons (N)
	kips (1000 lb)	4448	newtons (N)
Thermal Energy	British thermal unit (Btu)	1055	joules (J)
Mechanical Energy	foot-pounds (ft-lb)	1.356	joules (J)
	foot-kips (ft-k)	1356	joules (J)
Bending Moment or Torque	inch-pounds (in-lb)	.1130	newton-metres (Nm)
	foot-pounds (ft-lb)	1.356	newton-metres (Nm)
Pressure	pounds per square inch (psi)	6895	pascals (Pa)
	pounds per square foot (psf)	47.88	pascals (Pa)
Plane Angle	degrees (°)	0.0175	radians (rad)
Temperature	degrees fahrenheit (°F)	$\frac{°F - 32}{1.8} = °C$	degrees celsius (°C)
Concentration	parts per million (ppm)	1	milligrams per kilogram (mg/kg)

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NOTICE

The contents of this report reflect the views of the Division of New Technology, Materials and Research which is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY

1 OVERVIEW 1

2. OBJECTIVES 1

3. CONCLUSIONS AND RECOMMENDATIONS 2

4. IMPLEMENTATION 4

5. BENEFITS 4

6. BACKGROUND 5

7. MATERIALS AND METHODS 8

7.1 Bioassay Materials and Methods 8

7.1.1 Introduction to Bioassays 8

7.1.2 Algae Bioassays 9

7.1.3 Chironomid Bioassays 10

7.1.4 Snail Bioassays 11

7.1.5 Daphnia Bioassays 12

7.1.6 Fish Bioassays 14

7.1.7 Water 14

7.2 California Waste Extraction Test Materials and Methods 14

7.3 Sources of the Bridge Painting Materials Tested 14

7.4 Related Work Done by the Office of Structure Maintenance and Investigations 15

7.5 Materials Tested in the Bioassays 15

8. RESULTS 16

8.1 Results of the Literature Survey 16

8.2 Laboratory Results 17

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8.3 Tabular Summary of the Environmental Impacts of Bridge Painting 17

9. DISCUSSION 30

9.1 Discussion of Laboratory Results 30

9.2 Standard Special Provisions for Bridge Painting Projects 35

9.2.1 Standard Special Provisions for a Nonlead-Based Paint Over Water 35

9.2.2 Standard Special Provisions for Lead-Based Paint Over Water 35

9.3 Environmental Evaluation of New Products 36

9.4 Thoughts on Future Research 37

10. GUIDELINES 38

Section A-Aquatic Setting 38

Step 1. Determine the type (or types) of aquatic habitats that are within 1 kilometer of the project. 38

Step 2. Determine the beneficial uses of water in the affected system within 1 kilometer upstream or downstream of the project. 40

Section B. Nature of the Product 42

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Step 1. Determine the number of square feet of structure that will be cleaned and painted. 42

Step 2. Determine the amount and toxicity of detergent to be used to clean the bridge 42

Step 3. Determine the amount and toxicity of blasting abrasive to be used to clean the bridge. 43

Step 4. Determine the type of paint that is on the structure that will be painted. 43

Step 5. Determine the weight of the paint per square foot. 43

Step 6. Determine the weight of the paint material to be removed from the structure. 44

Step 7. Determine the toxicity of the paint to be removed. 44

SECTION C. DETERMINE THE AREA OF POTENTIAL ENVIRONMENTAL IMPACT (APEI) 44

Step 1. Bring forward from SECTION A Step 1 the type or types of aquatic habitats that exist within 1 kilometer upstream or downstream of the project. 44

Step 2. Bring forward from SECTION A Step 2 the beneficial uses of the water within 1 kilometer mile upstream or downstream of the project. 45

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Step 3. Use the following key to determine the APEI of the project. 45

Step 4. If there is any beneficial use of the water within 1 kilometer of the project site, consider the sites of those uses to be within the APEI. 49

SECTION D. DETERMINE THE IMPACTS TO AQUATIC ECOSYSTEMS 49

Step 1. Determine if the bridge painting waste to be produced is hazardous waste. 49

Step 2. Determine the Effects of Blasting Abrasives. 50

Step 3. Determine the Effects of Detergents or Other Cleaning Agents on the Aquatic Ecosystem. 53

Step 4. Determine the Effects of Paints and Coating Materials on the Aquatic Ecosystem. 55

Step 5. Determine the Combined Toxicant Impacts. 57

Step 6. Determine Any Additional Impacts. 58

SECTION E. SELECT MITIGATION ACTIONS FOR THE PROJECT. 59

Step 1. Mitigating for Hazardous Waste. 59

Step 2. Mitigating for Blasting Abrasive Toxicity. 59

Step 3. Mitigating for Increased Sedimentation. 60

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Step 4. Mitigating for Detergent or Cleaning Material Toxicity. 60

Step 5. Mitigating for Paint Toxicity. 61

Step 6. Mitigating the Formation of Scum on the Surface of the Water. 61

Step 7. Mitigating the Combined Toxicant Impacts 61

Step 8. Mitigating any Additional Impacts. 61

11. LITERATURE 63

11.1 Literature Cited 63
11.2 Literature on Paint Formulations 65

12. GLOSSARY 66

13. APPENDIXES
Appendix I Tests Data I-1
Appendix II Computer Programs II-1
Appendix III Paint Formulations III-1

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LIST OF TABLES

		Page
Table 8.3.1	*Physa gyrina* Bioassay Results	18
Table 8.3.2	Acute *Daphnia magna* Bioassay Results	19
Table 8.3.3	Chronic *Daphnia magna* Bioassay Results	20
Table 8.3.4	*Selenastrum capricornutum* Bioassay Results	21
Table 8.3.5	Rainbow Trout Bioassay and Fathead Minnow Bioassays	22
Table 8.3.6	California Waste Extraction Test Results	23
Table 8.3.7	San Joaquin River Bridge #29-50 California Waste Extraction Test (Performed by California Analytical Laboratories). Paint Contaminated Blasting Waste.	24
Table 8.3.8	San Joaquin River Bridge #29-50 EP Toxicity Test (Performed by California Analytical Laboratories). Paint Contaminated Blasting Waste.	25
Table 8.3.9	Mad River Bridge 04-25R California Waste Extraction Test (Performed by California Analytical Laboratories). Paint Contaminated Blasting Waste.	26
Table 8.3.10	Mad River Bridge 04-25R EP Toxicity Test (Performed by California Analytical Laboratories). Paint Contaminated Blasting Waste.	27
Table 8.3.11	Russian River Bridge #10-82 California Waste Extraction Test (Performed by California Analytical Laboratories). Paint contaminated Blasting Waste.	28
Table 8.3.12	Russian River Bridge #10-82 EP Toxicity Test (Performed by California Analytical Laboratories). Paint Contaminated Blasting Waste.	29

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EXECUTIVE SUMMARY

Introduction

The Water Quality and Solid Waste Branch of the California Department of Transportation's Division of New Technology, Materials and Research conducted research on the impacts to the aquatic environment of bridge painting materials. The study consisted of a literature survey of the subject and a bioassay study of materials used in bridge painting.

The objectives were to:

1 Determine the environmental impacts for existing paint systems and evaluate impacts of paint systems proposed for use.

2. Evaluate existing paint/abrasive system residue for disposal suitability.

3. Evaluate existing cleaning materials and abrasives for aquatic impact and develop a testing procedure to evaluate future materials.

4. Develop a method of analysis and reporting which addresses potential environmental impacts of a painting operation and which can serve as input for the environmental document.

5. Determine the toxicity of zinc spatter from an experimental cathodic protection system.

The materials tested were:

Black Beauty
Green Diamond
Starblast
EZ Blast
Kleen Blast
Lapis Luster and Clemco
PWB 80 paint
PWB 81 paint
PWB 83 paint

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PB 197 paint
Basic lead silicochromate paint
Red lead/ aluminum paint
Vinyl paint
Blast sand contaminated with red lead /aluminum
Husky Clean Machine Formula #1
Dowicil 75
Skane M-8
Zinc spatter from an experimental cathodic protection system. This material is not to be confused with zinc-rich paints.

The formulations of the paints tested are found in Appendix III. New paint formulations were artificially aged in the laboratory. It is realized that the artificially aged paints may not have the same toxicity characteristics as paint in the field on a bridge.

Conclusions and Recommendations

The following conclusions are based on the literature search and the laboratory analysis. These conclusions should be carefully applied to individual projects.

1. At some concentration, all of the paints tested caused toxic effects in one or more of the five species tested.

When toxic amounts of paint will be generated, shrouding or other precautions should be used to prevent toxic concentrations of paint material from occurring in the aquatic environment.

The import of this conclusion should not be overly expanded. It does not mean that any paint system should be rejected for use because of this report. It means that all of the systems tested had a concentration above which toxic effects may be expected to occur. Nearly every substance has a concentration above which toxic effects may be expected to occur.

2. Both lead and zinc contaminated blasting abrasive wastes are likely to contain enough lead or zinc, respectively, to be classified as a hazardous waste under California Law. Other states with different legal and the federal government frameworks do not classify zinc bearing blasting abrasive waste as hazardous waste.

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