

RESPONSIBLE MONITORING AND MANAGEMENT OF RESIDUAL FLOCCULANTS AND COAGULANTS TO PROTECT AQUATIC LIFE

Jacklyn Poole, B.Sc.
Charles Ehman, B. Sc.



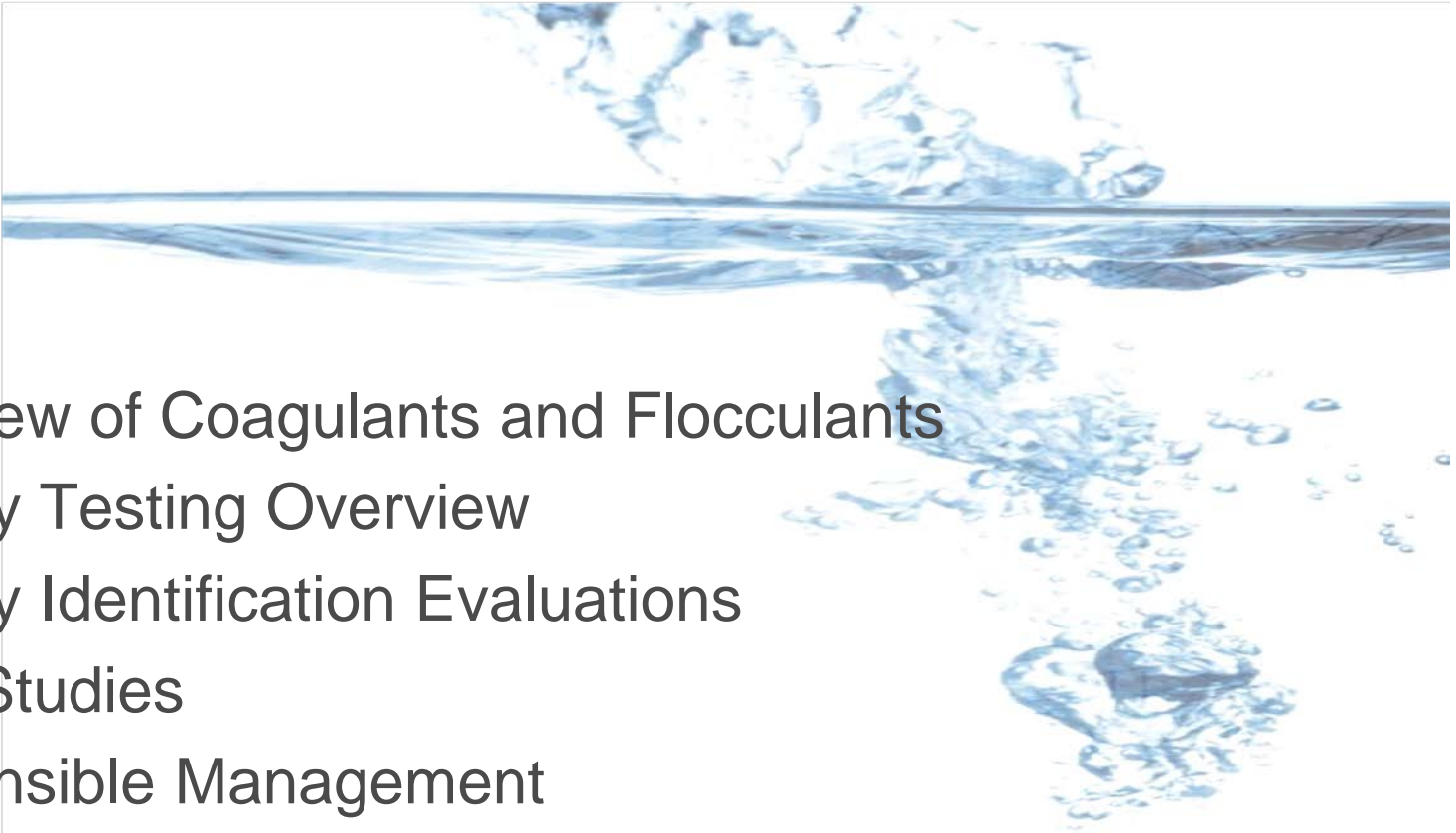
WaterTech Presentation 2014





OUTLINE

- Overview of Coagulants and Flocculants
- Toxicity Testing Overview
- Toxicity Identification Evaluations
- Case Studies
- Responsible Management



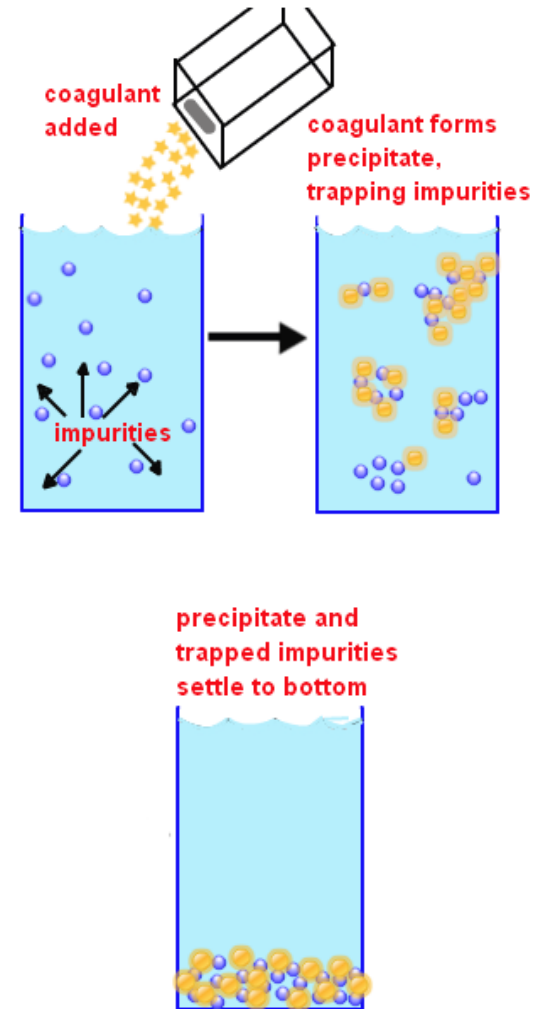


Flocculants and Coagulants

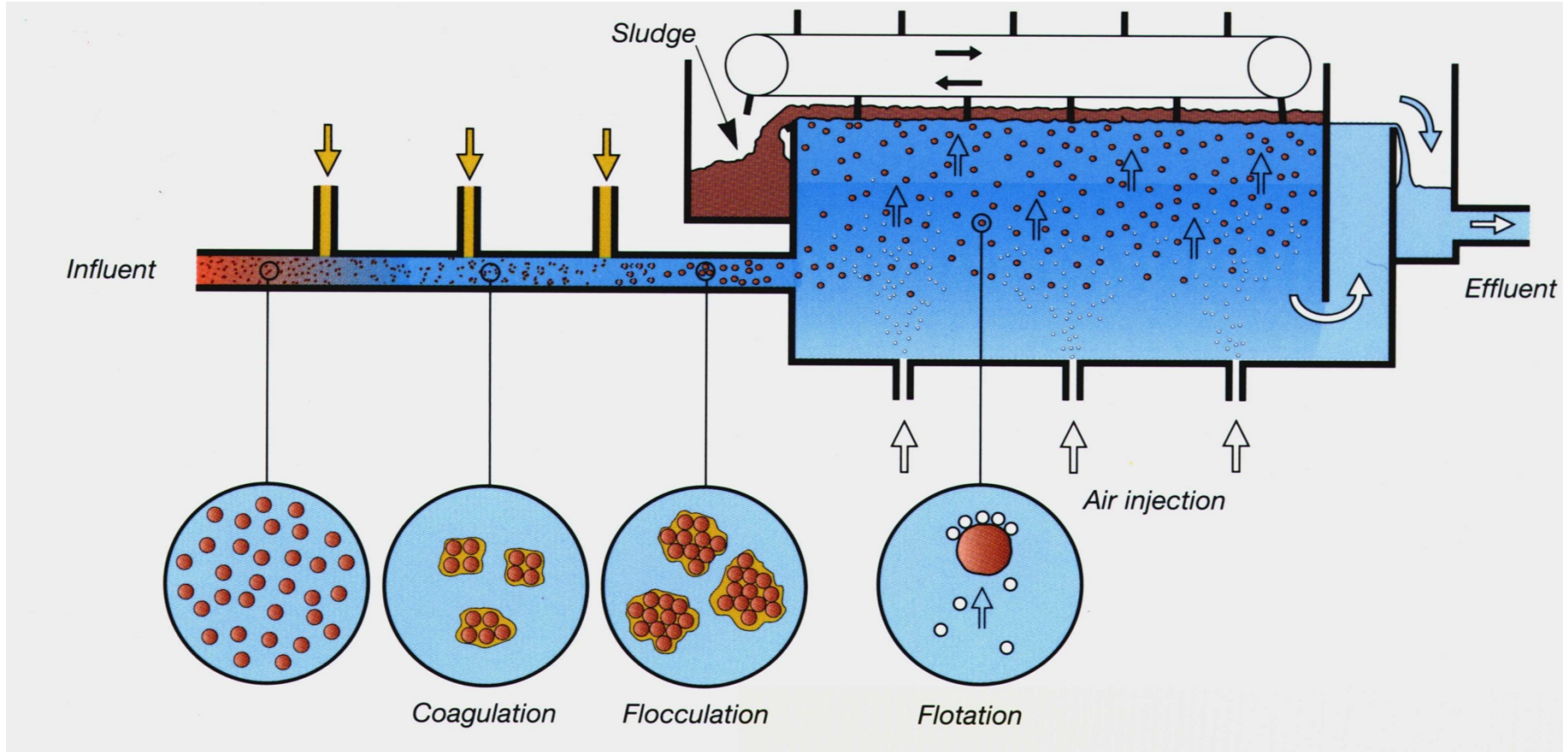
Overview

What are Flocculants and Coagulants?

- Used by several industries to separate suspended solids from effluents
- **Coagulants**
 - Added to form precipitates (“floc”) of suspended solids
- **Flocculation**
 - Gentle mixing stage
 - High molecular weight polymers are added to bind and strengthen floc
 - Increases the particle size
- **Sedimentation**
 - Floc is filtered or settled out



What are Flocculants and Coagulants?





Environmental Implications

- What are the potential environmental effects of residual coagulants and flocculants?
 - Case Studies
- How to determine if an effluent is toxic and what to do if it is?
 - Toxicity Testing
 - Toxicity Identification Evaluations





Toxicity Testing

Overview



Ecotoxicology



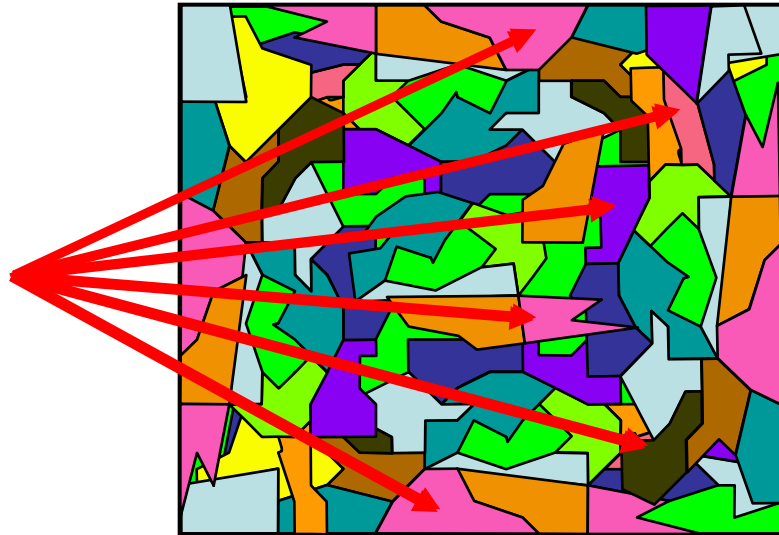
- Branch of toxicology
- Toxic effects of chemicals and physical agents on living organisms, especially on populations and communities with defined ecosystems



Chemistry Approach

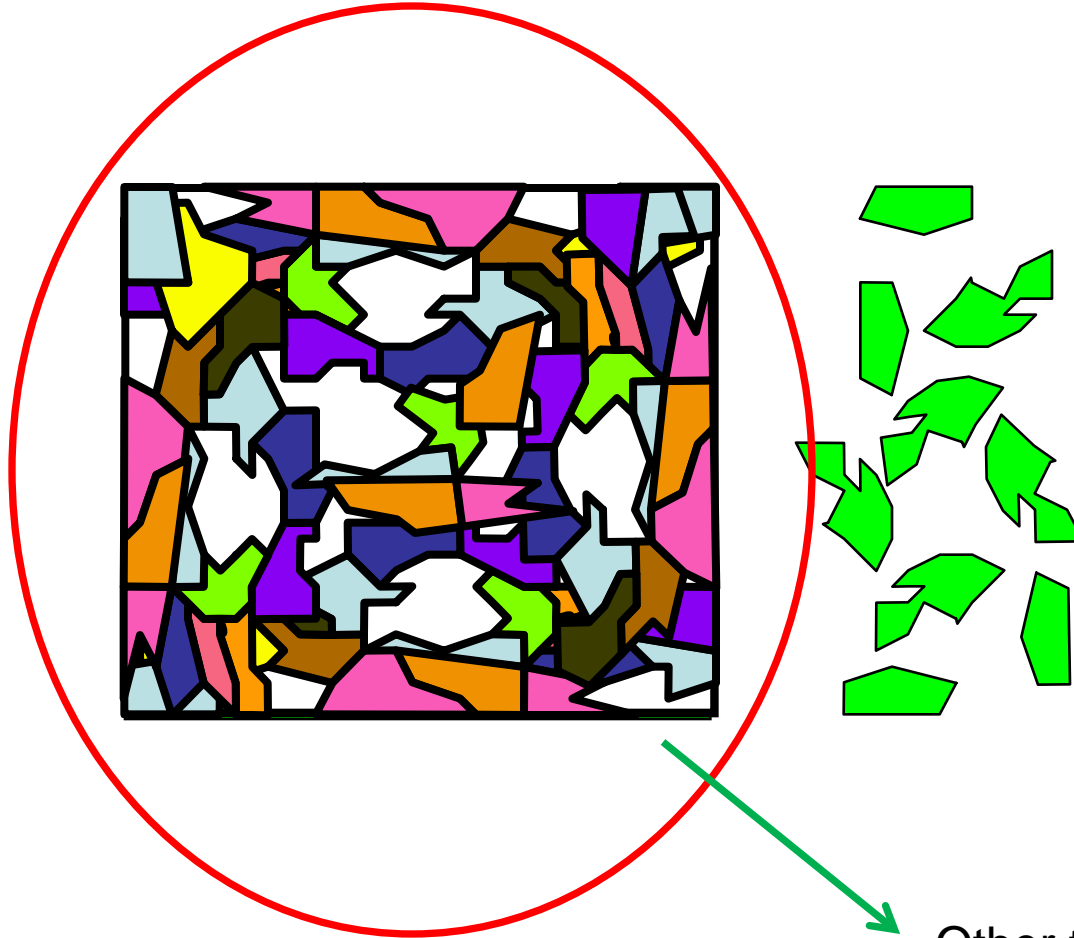
- Environmental samples are complex mixtures

parameter
specific





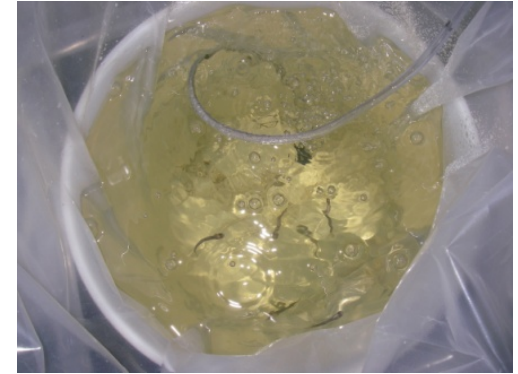
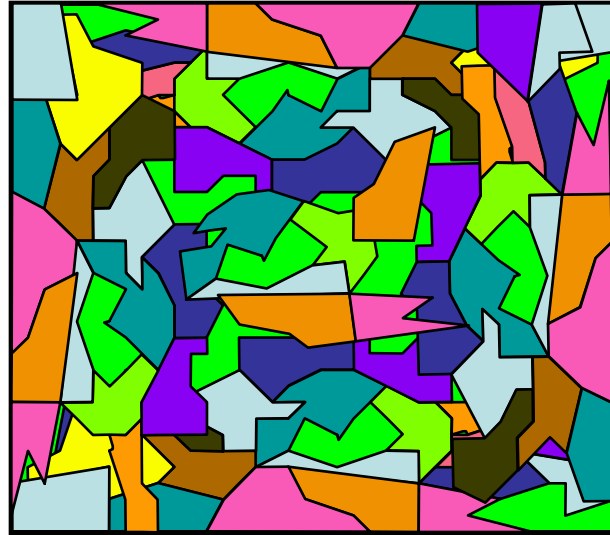
Chemistry Approach



Other toxicants may be missed



WET Testing



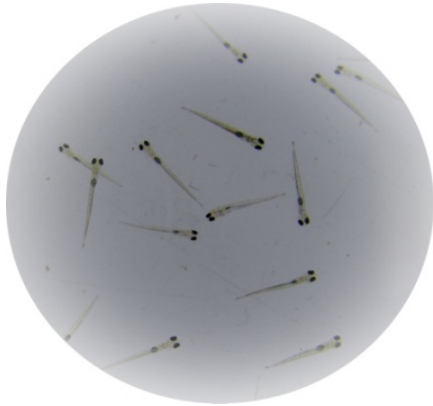
 **integrated
response**



Toxicity Testing Definitions



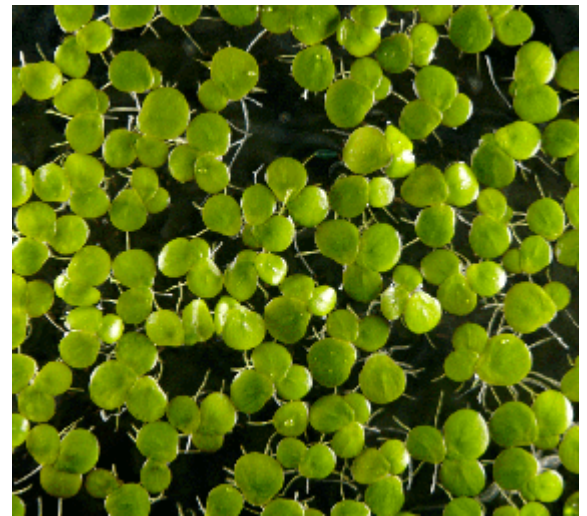
- Whole Effluent Toxicity (WET) test
 - Used to measure, predict and control the discharge of materials that may be harmful to aquatic life
- Acute (Lethal) Toxicity
 - Short duration exposure (48 and 96 hour tests)
 - Survival and behaviour
- Chronic (Sublethal) Toxicity
 - Long (relative to the organism's life span) or repeated exposures
 - Lethal or sublethal effects (e.g. growth or reproduction)





TOXICITY TESTING

- Acute Test
 - 48 hour *Daphnia magna*
 - 96 hour Rainbow trout
 - 15-min Luminescent bacteria
- Chronic Tests
 - 72 hour Algal growth
 - 7-day *Lemna minor* growth
 - 5 to 8 day *Ceriodaphnia*
 - 7-day Fathead minnow



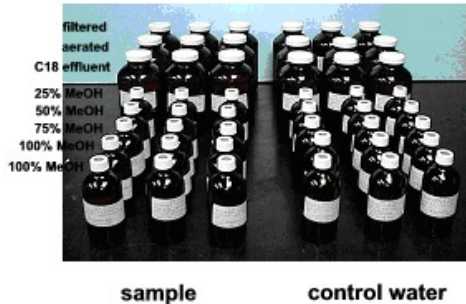


T.I.E.

Toxicity Identification Evaluation

Toxicity Identification Evaluation

TIE Fractions for Testing



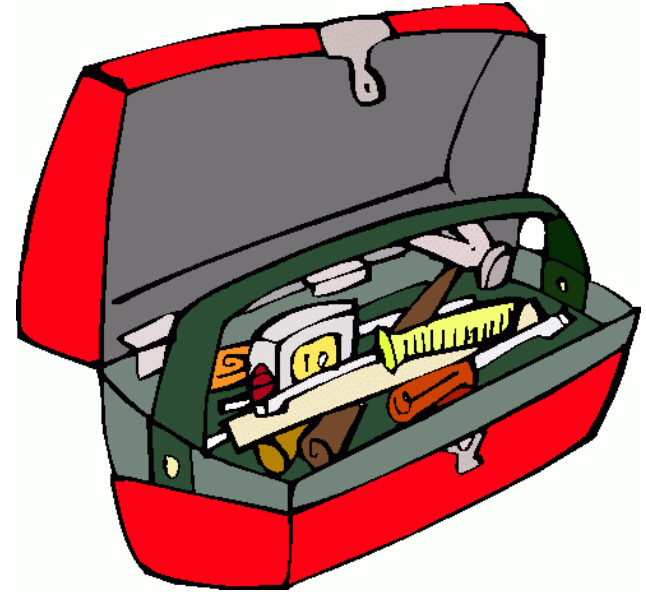
- If a **toxic result** is observed in a test species of interest the cause of toxicity may want to be determined
- **Toxicity Identification Evaluations (TIEs)**
 - Process for identifying the bioactive constituents or properties of a sample
 - Involves confirmation, isolation, identification, and confirmation of effects
 - Customized for each sample type





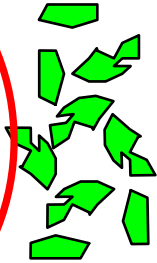
Toxicity Identification Evaluation

- Tools that can be used:
 - Sample fractionation
 - pH adjustment
 - Size exclusion testing
 - Simulated sample
 - Standard additions
- Success is a result of experience, collaboration (biological testing and chemical analysis) and taking a weight of evidence approach





Toxicity Identification Evaluation



- TIE is organized into 3 phases
 - Phase 1 – Characterization
 - Identification of broad classes of chemicals causing toxicity
 - Phase 2 – Identification
 - Chemicals of concern are further narrowed down
 - Phase 3 – Confirmation
 - Verification of chemicals of concern through additions/spiking toxicity experiments



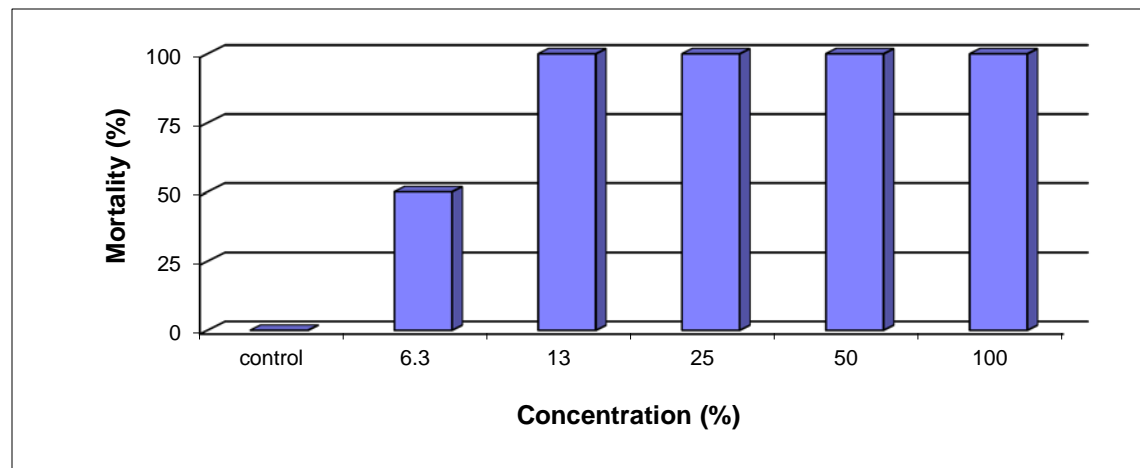
Case Studies



Case Study #1

Coal Mining Effluent

- Pond effluent sample showed toxicity to Rainbow Trout and *Daphnia magna*
- Fast acting toxicant
- Toxicity Identification Evaluation performed



Rainbow Trout mortality after 96 hour effluent exposure



Case Study # 1

■ Coal Mining Effluent

- Sample Fractionation
 - Manipulations of the sample showed the toxicant to be a large polymer
- Size Exclusion Testing
 - Determined that the toxicant size was greater than 50,000 daltons in size
- Humic Acid Testing
 - Decreased toxicity by binding to potential toxicant
- Toxicant was identified to be an amine polymer flocculant





Case Study #2

Chemical Plant



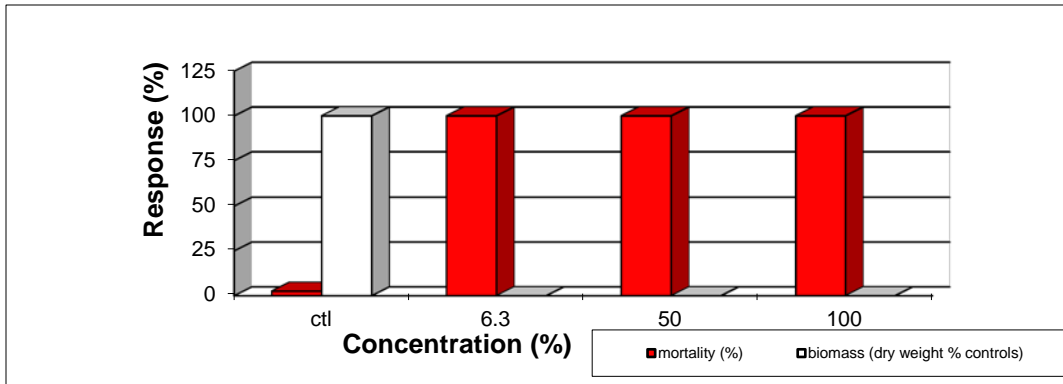
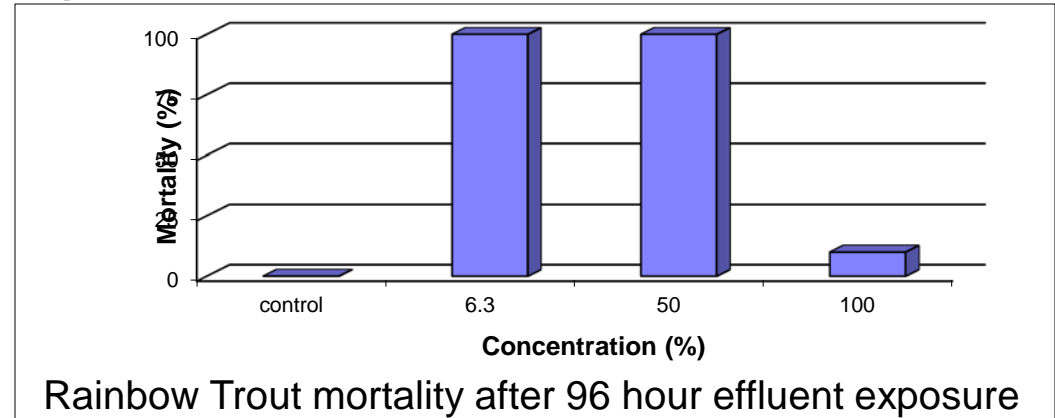
- Monthly effluent sample showed toxicity to Fathead Minnows, *Daphnia magna* and atypical result in Rainbow Trout



Case Study #2

Chemical Effluent

- Fast acting toxicant
- Toxicity Identification Evaluation performed



- Conclusions
 - Toxicant was identified to be coagulant



Responsible Management



Fisheries Act



- “No person shall carry on any work, undertaking or activity that results in **serious harm** to fish that are part of a **commercial, recreational or Aboriginal fishery**, or to fish that **support** such a fishery.”



Fisheries Act

Environment Canada

www.ec.gc.ca

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Wildlife Enforcement

City of Moose Jaw Fined \$55,000 for Violation of Fisheries Act

MOOSE JAW, Sask. -- August 5, 2010 -- The City of Moose Jaw pleaded guilty on August 4, 2010 to one offence under the *Fisheries Act* for depositing a deleterious substance into fish-bearing waters and was fined a total of \$55,000, which includes a \$5,000 fine and order to pay \$50,000 to the Environmental Damages Fund.

<http://www.ec.gc.ca/alef-ewe/default.asp?lang=En&n=66BCC6A-1>



Fisheries Act

Environment Canada
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News Release

Town of Ponoka Pleads Guilty and is Fined \$70,000 for Release of Wastewater to Battle River

PONOKA, Alta. -- **December 7, 2011** -- The Town of Ponoka, Alberta, was fined \$70,000 in Alberta Provincial Court after pleading guilty to one count under the *Fisheries Act*, related to the release of municipal wastewater into the Battle River. Environment Canada received a complaint regarding dead fish in the Battle River in June, 2009. An investigation found that the Town of Ponoka was releasing effluent from their wastewater lagoon into the Battle River. Sample analysis of the effluent determined that it was harmful to fish.

<http://www.ec.gc.ca/default.asp?lang=En&n=714D9AAE-1&news=E5A11B36-398F-4AF1-8086-42AA9507C545>



Toxicity Testing

- Rainbow Trout Screening Tests
 - Easy, efficient way of determining if effluent is acutely toxic
 - 96 hour test





Rainbow Trout Toxicity Testing



- Standard cool-water fish for freshwater eco-toxicology testing
- Designed to measure adverse effects of different environmental conditions on trout young.



THANK YOU

CONTACT INFORMATION:

Jacklyn Poole, B.Sc

Email: jacklyn_poole@golder.com

Charles Ehman, B. Sc

Email: charles_ehman@golder.com