STORMWATER ENVIRONMENTAL ISSUES AT WOOD PRESERVATION/WOOD PROTECTION FACILITIES

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1.0 INTRODUCTION

The Canada Federal Fisheries Act includes in part, Section 36(3) which states that:

> *"no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish ...... ".*

Initially, regulators used this Section of the Act to control point source discharges into the environment. However, its use has also been extended to the control of releases of stormwaters from industrial sites, such as, sawmills and wood preservation facilities. Two means are used to determine whether 'deleterious substances' are released to the environment:

- a laboratory bioassay test whereby fish, such as Rainbow trout are exposed to the effluent for a period of 96 hours (if more than 50% of the fish die after 96 hours, then the effluent is considered to be 'deleterious'); and/or,
- assessment of concentrations of chemicals in the effluent to determine if they are at levels which may affect the health of aquatic biota.

The British Columbia Ministry of Environment has an Antisapstain Chemical Waste Control Regulation which parallels the Fisheries Act, and specifies the maximum concentrations of antisapstain chemicals which may be present in stormwaters from sawmill sites. In addition, the regulation specifies that the stormwaters discharged from sawmill and export terminal sites (where antisapstain treated wood is stored), must pass the Rainbow trout 96-hr LC_{50} test. The B.C. Ministry has indicated that it intends to extend this regulation to include the wood preservation industry. Recently, log yard stormwater runoffs have been targeted by regulatory agencies, particularly in Northern B.C. Envirochem Special Projects Inc. has undertaken numerous studies of stormwater quality from sawmill and wood preservation sites and has determined numerous key findings which suggest the need for a review of regulatory approaches for fair control of stormwater discharges.

2.0 RESULTS AND DISCUSSION

2.1 "The Toxicity of Stormwater Effluents May Not Be Related to the Concentrations of Wood Protection/Preservation Chemicals"

Figure 1 plots the concentrations of DDAC versus fish toxicity for over 500 stormwater samples. Although 85% of the samples contained DDAC concentrations below the reported 96-hr LC_{50} of 466 ppb for DDAC, more than 65% of the samples failed the 96-hr LC_{50} test. Detailed analyses of other chemicals, such as IPBC, indicates that for most samples, the target antisapstain chemicals were not the causes of the observed toxicity (Brooks *et al*, 1996).

Other sources of toxicity include:

- zinc from galvanized roofs and other sources. A zinc concentration of 1.7 mg/L was found in eaves trough water at one wood preservation plant, (versus a toxicity value of approximately 0.09 mg/L at low hardness). A study by MacMillan Bloedel attributed zinc as the source of toxicity observed in six of nine stormwater samples from a sawmill site (Potter, 1996);
- wood leachate [e.g. Envirochem (1994) reported toxicity in leachate waters from an untreated bundles of wood]; and,
- hydraulic and lubricating oils, however, the concentrations typically found in stormwaters at mill sites are generally much less than reported toxicity values.

It is likely that there may be other unidentified sources of toxicity, e.g. end seal paint formulation, iron stain control chemicals, etc.

2.2 "The Chemical Quality of Rainwater (Which Makes Up Stormwater) Enhances the Toxicity of Wood Preservatives and Wood Leachates"

Rainfall is of low pH (e.g. 4.8-6.0), low buffering capacity and with low concentrations of calcium and magnesium. Under such conditions, metals such as copper and zinc, and organic compounds such as pentachlorophenol and resin acids, become more toxic.

Table 1 illustrates how pH affects the toxic effects of pentachlorophenol (Saarkoski, J. and M. Viluksela, 1981), and Table 2 shows how hardness will affect the toxicity of copper (Demayo, A. and M.C. Taylor, 1981).

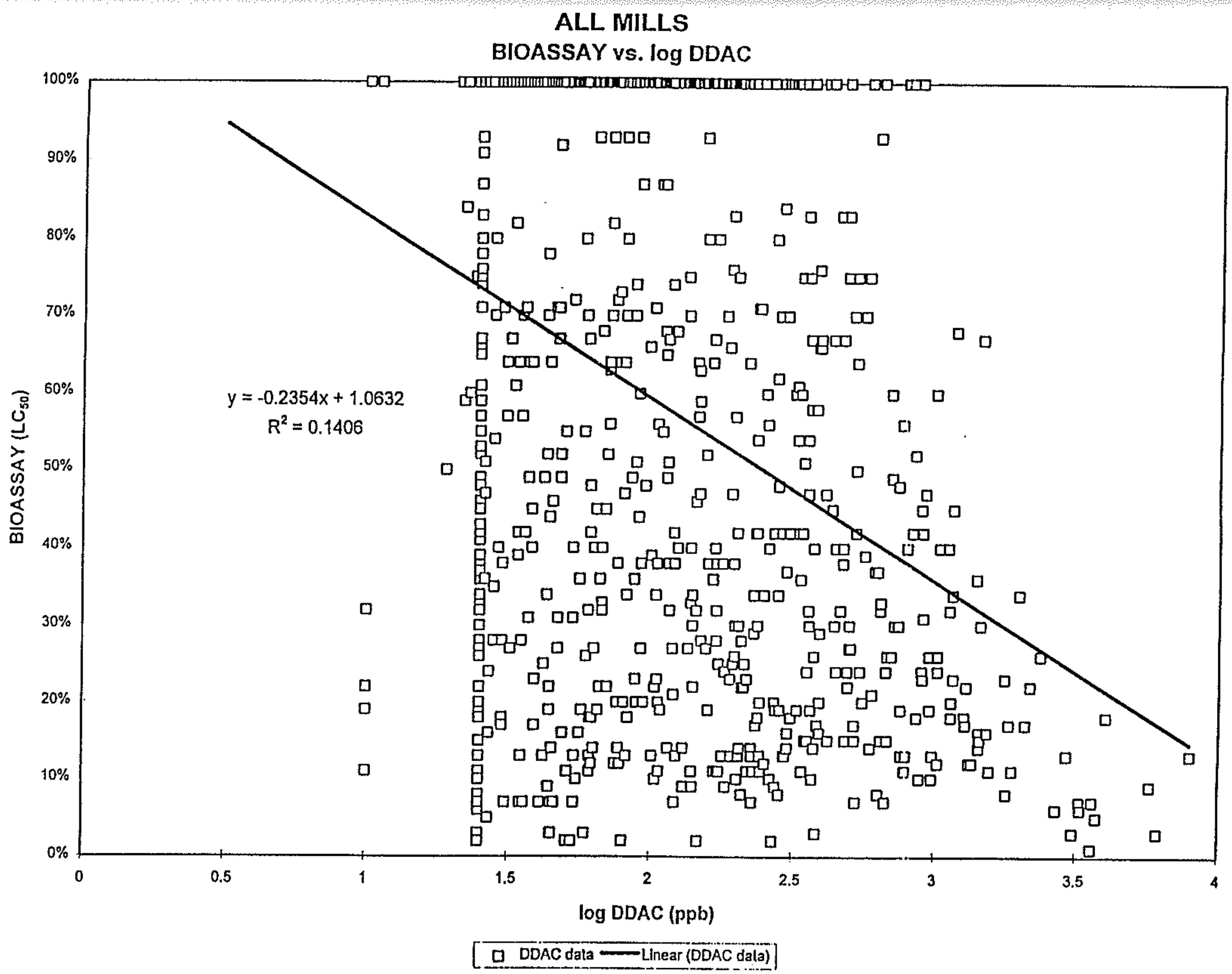

Figure 1 Relationship between DDAC Concentrations and Toxicity for all Mills

Table 1

Impact of pH on PCP Toxicity to Guppies

pH	96-hr LC_{50} mg/L
5.0	0.043
6.0	0.107
7.0	0.442
8.0	0.906

Saarikoski, J. and M. Viluksela, 1981. *Influence of pH on the Toxicity of Substituted phenols to Fish.* Arch, Environ. Contam. Toxicol. 10:747-753

Table 2

Influence of Hardness on the Toxicity of Copper to Fish

Species	Hardness mg/L as $CaCO_3$	96-hr LC_{50} mg Cu/L
Cutthroat trout	14	0.025
Coho Salmon	88-99	0.06 - 0.074
Cutthroat trout	205	0.367

Demayo, A. and M.C. Taylor, 1981. *Guidelines for Surface Water Quality - Copper, Inland Waters Directorate.* Ottawa.

Table 3 shows how an increase in hardness reduces the toxicity of a stormwater effluent from a CCA wood preservation plant (Envirochem, unpublished results). The table also shows that the addition of EDTA removed the toxicity of the effluent. EDTA has complexed the 'free metals', hence metal availability to fish has been reduced.

Preliminary results of a toxicity study on effluent from a paved log yard showed that an increase in pH results in reduction of toxicity. Effluent from an unpaved portion were non-toxic, suggesting that the lack of buffering in runoff waters exacerbates toxicity.

Table 3

Assessment of Means to Reduce Toxicity of CCA Stormwaters

Chemical Characteristics	
pH:	5.18
Hardness:	15.7 mg/L as $CaCO_3$
Dissolved Arsenic:	0.1 mg/L
Dissolved Chromium:	0.287 mg/L
Dissolved Copper:	0.07 mg/L
Toxicity Results	
LC_{50}:	27%
LC_{50} after EDTA addition:	>100%
LC_{50} after increasing hardness to 195 mg/L:	>100%

2.3 "Use of the Standard 96-hr LC_{50} Rainbow Trout Bioassay Will Likely Over-Estimate the Impacts of Stormwaters on Receiving Environments"

The median pHs of the Fraser River vary from 7 to 8 (Drinnan and Clark, 1980) and marine water pHs are in the order of 8.0 - 8.2. The median hardness in the Fraser River ranges from 40 to 60 mg/L (Drinnan and Clark, 1980). The pHs of stormwater effluents generally range from 5.2 to 6.8, hence on the basis of data in Section 2.2, the toxicity of effluents with metals or pentachlorophenol will likely decrease upon discharge to the Fraser River waters or marine waters.

Recent studies have shown that DDAC in stormwaters likely adheres to suspended solids in waters, such as those of the Fraser River (Figure 2). In this situation, the bioavailability of DDAC is likely decreased. On the other hand, recoveries of IPBC are not affected by suspended solids.

Further receiving environment studies are planned by the Coast Forest and Lumber Association.

2.4 "The Existing Regulatory System in Canada is Too Complex to Enable Good

Cost-Effective and Scientific Management of Stormwater Discharges"

There are too many inter- and intra departmental differences to enable the derivation of cost-effective strategies for the control of discharges to the environment. As an example, one agency has supported investigation of receiving environment impacts, and another has stated that such studies would be irrelevant.

2.5 "Technical Options for Control of Stormwater Discharge Quality are Best Focused at the Sources, Rather Than at the End of the Pipe"

Regular stormwater monitoring provides a good means of assessing chemical use practices. Elevated antisapstain concentrations (above reported levels of concern for protection of aquatic life) are now generally uncommon in stormwaters, however, where elevated concentrations are observed, causes such as poor application methods are indicated. Likewise, releases of elevated concentrations of wood preservation chemicals in stormwaters may be an indication of poor operational procedures. On the other hand, with the use of improved control technologies, as evident in the decreased levels of releases of chemicals compared to historical releases, it appears the industry still is faced with the issue of stormwater toxicity.

Due to the size of sawmill and wood preservation sites, large volumes of stormwater are generated. As an example, a 75 percentile volume of 994 imperial gallons per minute was estimated at one logyard. The capital costs for a biological treatment option to reduce toxicity was estimated to be $9 million for a system which would require the space of approximately the size of a football field. A supplier offered the installation of an oxidative process for which lease costs would be in the order of $15,000 to $23,000 per month, exclusive of power costs. Such costs and associated space requirements are generally beyond budget capabilities at most mills. Another option is roofing at a cost of approximately one million dollars per acre. Such requirements would place a competitive disadvantage to the Canadian industry given that stormwater toxicity is not an issue in other countries, such as the United States.

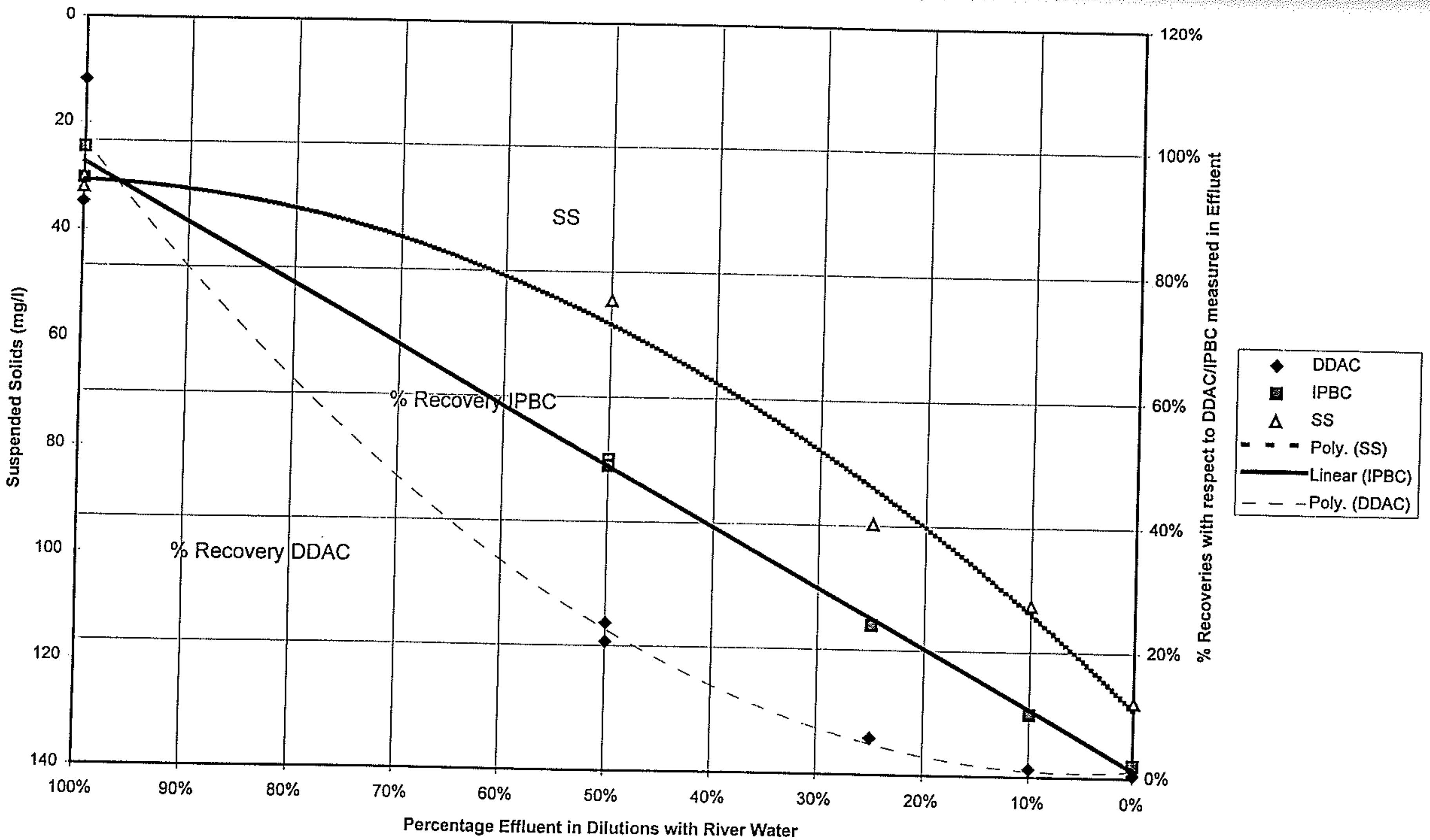

Figure 2 Assessment of DDAC/IPBC Recoveries in River Water

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3.0 RECENT AND ONGOING STUDIES

To further the understanding of the toxicity of stormwaters from timber processing operations, the following studies are known to have been completed or are underway in British Columbia:

- technical review of antisapstain environmental issues [by Brooks *et al* (1996), sponsored by the Antisapstain Stakeholder Group];
- assessment of antisapstain chemicals concentrations in the Fraser River [underway by Envirochem, (1997), sponsored by Environment Canada];
- identification of toxic components of logyard runoff [underway by EVS Consultants (1997), sponsored by the Coast Forest and Lumber Association];
- assessment of receiving environment impacts of logyard runoffs [to be started by EVS Consultants (1997), sponsored by the Coast Forest and Lumber Association]; and,
- identification and treatment of toxic components in wood leachates [underway by Duff, UBC].

4.0 CONCLUSIONS

- The regulatory attention on stormwater toxicity is a difficult challenge to the industry. The very nature of rainwater itself, exacerbates toxicity of very small quantities of chemicals, particularly when industrial yards are paved and there is no opportunity for buffering or increase in pH. As a result, trace releases of wood extractives, wood preservatives and even releases from galvanized or aluminum roofing may cause contravention of the Fisheries Act.

- There is a need to review the regulatory approaches to the enforcement of the Fisheries Act. Recent science shows that optional approaches should be used for control of stormwater discharges. In a survey of regulatory approaches throughout the world, a trend is found in that bioassays are used screening tools rather than as endpoints. There should be an option of evaluating receiving environment impacts if the bioassay tests show evidence of potential concerns.

- There is a need to develop an acceptable procedure for evaluating actual environmental impacts of stormwater discharges.

- There is a need to simplify the regulatory process to enable cost-effective and scientific management of the environment.

5.0 REFERENCES

Brooks, K.M., D.E. Konasewich, H.C. Bailey, E.B. Szenasy and G.E. Brudermann, 1996. *Antisapstain Chemical Technical Review.* Prepared for the Sub-Committee on Antisapstain Chemical Waste Control Regulation Amendments of the B.C. Stakeholder Forum on Sapstain Control. Vancouver, B.C.

Drinnan, R.W. and M.J.R. Clark, 1980. *Fraser River Estuary Study - Water Quality: Water Chemistry, 1970 - 1978.* Ministry of Environment. Victoria, B.C.

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