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HASKELL LABORATORY FOR TOXICOLOGY
AND INDUSTRIAL MEDICINE
ELKTON ROAD, NEWARK, DELAWARE 19711

CENTRAL RESEARCH AND DEVELOPMENT DEPARTMENT

M. W. Kirkwood, DuPont, Canada

C-1516

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T. M. TUSZYNSKI
MAITLAND WORKS
DU PONT CANADA LTD.
MAITLAND, ONTARIO
KOE 1PO
CANADA

REVIEW OF THE REPORT ON THE BENTHIC SURVEY
BY AMIK REGARDING LEAD POLLUTION PROBLEMS

The current standards for lead in the environment are: 50 ug/gm (Ministry of the Environment for Ontario Province) (MOE) and range from 1.0 to 64, based on water hardness, (US EPA, Fed. 49 (26):4553, Feb. 7, 1984). Attachment I includes Tables 1 and 2 from the AMIK report showing the MOE criteria for acceptability of dredged material and the chemical compositions used to designate Great Lakes Harbours as heavily polluted, moderately polluted or nonpolluted.

The AMIK study involved an analysis of the water quality, sediment quality, and benthic population for a distance of 8 km downstream of the Maitland Plant as well as a 2 km area upstream of the plant site and a zone immediately downstream of the Du Pont outfall. The results of that study have been adequately summarized in the AMIK Report; a copy of that summary is attached, Attachment II.

Appendices 8-10 of the report contain the information regarding the procedures used in obtaining the data. In Appendix 8 The Shannon-Weaver Diversity Index, which is an accepted procedure for evaluating species diversities, is correctly described. The importance of this concept to ecologists is that as an area becomes stressed, for whatever reason, the diversity of the organisms capable of living and reproducing in that environment becomes restricted. This restriction means that the population is less able to withstand further insults, the gene pool is more limited, and these additional insults can result in

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a "crash" of the ecosystem. At that point, then, only a very few, extra hardy forms can survive and these are usually not the desirable species (from commercial or recreational needs).

The analytical procedures used to determine the heavy metal concentrations in the water and sediments are described in AMIK, Appendix 10. The methods used are standard and the only unusual feature is a rather high detection limit for lead in sediments (5000 ng/g). This may reflect the small sample size of sediment digested (0.25 g).

Data analysis on specific heavy metals indicates that while chromium and zinc are elevated above any of the acceptable standard levels, this is a generalized problem and cannot be associated with Du Pont activities. Nickel, however, had only 9 samples outside of the MOE standard, and 8 of these were downstream of the Maitland Plant outfall. Lead concentrations directly in the outfall sediments were also higher than permitted by either the US EPA or MOE with a mean background concentration of 40 mg/kg, which is 65% higher than noted in the 1975 study. Copper concentrations were also slightly elevated downstream of the Du Pont plant, but this appeared to be somewhat restricted to the deeper sediments. This could reflect earlier practices at the plant or downstream transport from an upstream source. Given the data and information currently available, it is not possible to differentiate between these possibilities. Copper is generally immobile in sediments; this is, it does not undergo biological transformations and recycling as do lead, mercury, arsenic, and selenium.

The discussion on the biological diversity of the three study zones accurately reflects the data gathered. It does appear that the benthic community has recovered, or at least has not been severely impacted, by the Maitland Plant activities at a point 4 km downstream. There is also no doubt that there is severe biological impact immediately adjacent to the plant outfall. Given an historical base, it might be possible to determine, via a modeling effort, whether the zone of influence of the plant outfall is increasing. Since the diversity index increase downstream is gradual and the return to a mixed population not dominated by the oligochaetes (worms) is also gradual, one should be cautious in estimating the biological zone of impact and in stating that the benthic community has returned to normal levels 4 km downstream. This may be true based on the data in this AMIK study, but the field data should be used to predict the potential of future impact areas and to determine if, indeed, the region 30 m downstream is remaining as the limit of the zone of biological impact.

The second AMIK survey, October 1983, was concerned more specifically with lead in the water, sediments, benthos, and fish. The MOE guidelines are 25 ppb for lead in the water with a maximum of 50 ppb in drinking water. Lead concentrations in the effluent exceed the former concentration and approximate the latter levels. At 30 m downstream the lead concentrations are 1-6 ppb but they are 4-18 ppb at the 90 m sampling station. This implies an enrichment of lead in the water column, most probably from release from the sediments.

Sedimentary lead levels are 2.5 times above the MOE limits for lead at the plant outfall. This gradually decreases to about one-half the MOE limit of 50 ppb in a plume downstream that includes both deeper sediments and sediments taken at a depth equivalent to the plant outfall.

The overall organic lead levels are low, <5 ppb, but no limits have been set for organic lead in the environment. It should also be noted that organic lead is more soluble; but, to date, no analyses for it have been made in the water column. It is also this form of lead which is more readily adsorbed by organisms, so the <5 ppb level may be misleading.

Analysis of lead in whole fish and fillets of perch and suckers does indeed indicate that a bioconcentration factor (BCF) of approximately 2.5×10^3 and 7.5×10^3 has occurred for fillets and whole fish, respectively. These calculations are based on the fish levels and the mean downstream water levels of lead at the 30 m and 90 m sampling stations and do not reflect either the outfall concentrations of lead or lead in the sediments. For comparison, fish caught upstream of Maitland and analyzed for lead had BCF values of 3.4×10^2 and 4.4×10^2, and order of magnitude less.

Therefore, the AMIK conclusion that the outfall is not contributing to the lead concentrations in fish is only partially supported by the data they present. Because fish migrate and it is impossible to know their exact swimming and feeding history, one can neither prove or disprove that the lead from the Maitland site is contributing to this problem. Certainly, however, knowing that lead is being released to the river, makes the MOE consider Du Pont a prime suspect in causing this bioconcentration of lead in commercial fish species.

<u>Recommendations:</u>

- reduce outfall levels of lead to as low as possible;

- continue to monitor the lead concentrations in the water column, sediments, and fish in the area above the outfall, at the outfall and at the 30 m and 90 m downstream stations;
- begin an examination of the plankton or algae which are growing in these regions as they may be concentrating the lead more than the fish which are then only consuming an already polluted food source;
- perform on-site biomonitoring with fish to determine the actual BCF under the existing lead and other environmental conditions; and,
- perform sampling under different seasonal conditions, such as winter cold, summer heat, and the typical spring and fall algal blooms.

Carol D. Litchfield

CAROL D. LITCHFIELD
SECTION SUPERVISOR, ENVIRONMENTAL BIOLOGY

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Attachment I

TABLE: 1

ONTARIO (MOE) CRITERIA OF ACCEPTABILITY FOR OPEN WATER DISPOSAL OF DREDGED MATERIALS* (IWG, 1975; GLWQ BD.1982)

VARIABLE	MAXIMUM PERMISSIBLE CONCENTRATION
Loss on Ignition	6%
COD	50 g/kg or 5%
Total Kjeldahl Nitrogen	2 mg/g
Total Phosphorus (AS P)	1 mg/g
Mercury	0.3 mg/kg
Lead	50 mg/kg
Zinc	100 mg/kg
Iron	10,000 mg/kg or 1%
Chromium	25 mg/kg
Copper	25 mg/kg
Arsenic	8.0 mg/kg
Cadmium	1.0 mg/kg
Cyanide	0.1 mg/kg
Ammonia	100 mg/kg
Nickel	25 mg/kg

* Analyses must be on a dry weight basis.

IWG 1975 = International Working Group on the Abatement & Control of Pollution from Dredging Activities

GLWQ BD. 1982 = Guidelines & Register for Evaluating Great Lakes Dredging Projects (Report to the Great Lakes Water Quality Board)

TABLE 2a: EPA 1977 GUIDELINES

(FROM IJC UPPER LAKES REPORT APPENDIX C)

RANGES USED TO CLASSIFY GREAT LAKES HARBOURS

VARIABLE	STATUS		
	NON POLLUTED	MODERATELY POLLUTED	HEAVILY POLLUTED
COD	<40,000	40,000 - 80,000	>80,000
TKN	<1,000	1,000 - 2,000	>2,000
LEAD	<40	40 - 60	>60
ZINC	<90	90 - 200	>200
MERCURY	<1.0	——	>1.0

(Ranges in mg/kg)

TABLE 2b: SUPPLEMENTARY RANGES (POORER DATA BASE)
USED TO CLASSIFY SEDIMENT FROM GREAT LAKES HARBOURS

VARIABLE	STATUS		
	NON POLLUTED	MODERATELY POLLUTED	HEAVILY POLLUTED
AMMONIA	<75	75 - 200	>200
CYANIDE	<0.10	0.10 - 0.25	>0.25
PHOSPHORUS	<420	420 - 650	>650
IRON	<17,000	17,000 - 25,000	>25,000
NICKEL	<20	20 - 50	>50
MANGANESE	<300	300 - 500	>500
ARSENIC	<3	3 - 8	>8
CADMIUM	*	*	>6
CHROMIUM	<25	25 - 75	>75
BARIUM	<20	20 - 60	>60
COPPER	<25	26 - 50	>50

(Ranges in mg/kg Dry Weight)

* Lower limits not established.

Attachment II

SUMMARY

St. Lawrence River water quality, sediment, and benthos were investigated for an 8 km distance of the river in the vicinity of Du Pont Canada's Maitland Works Plant.

Three zones of influence were identified in the study area. The initial or upstream zone located off Maitland village showed water nutrients and bacteria levels within MOE provincial water quality objectives but had heavy metal and nutrient concentrations in the sediment exceeding both MOE guidelines, and reported Lake Ontario Basin averages. The highest benthic diversity and richest species assemblage, specifically Chironomidae occurred at this site. The high benthic diversity may indicate a static deposit of contaminants rather than an active point source.

The second zone of influence occurred in the vicinity of Claybank Bay approximately 2 km upstream from the Du Pont outfall. This zone was characterized by ammonia and bacteria at levels well above the MOE guidelines. The highest Pseudomonas aeruginosa, total, and fecal coliform levels recorded in the study occurred in the near shore zone of Claybank Bay. These elevated levels may be an indication of an onshore sanitary waste source. Sediment nutrient levels were within MOE guidelines with the exception of one near shore site downstream of Claybank Bay. The Chemical Oxygen Demand percentage determined for the Claybank sediments was the survey area maximum with the peak value exceeding the MOE guideline by 300%. The benthic communities in this area represented moderately polluted environmental conditions. A gradual reduction in benthic diversity was noted. The appearance of Manayunkia speciosa and other annelids downstream of the bay was considered to be an indicator of an environmental quality change. The elevated parameters for water and sediment were thought to be caused by an industrial point source within the Claybank Bay area.

The third zone of influence occurred immediately downstream of the Du Pont outfall. Water quality along the transects was in compliance with MOE guidelines. Sediment, however, showed elevated lead levels above MOE guidelines for a distance of 300 m downstream of the outfall. Elsewhere,

lead levels were below the guidelines. The mean lead concentration for the whole Maitland study area based on 27 samples was 23 ±28 mg/kg. This was lower than the lead values reported in a 1975 MOE study and also lower than the reported mean lead concentration for the whole Lake Ontario Basin of 154 ±43 mg/kg.

Analysis of mixing zone water samples, 30 m and 90 m downstream of the Du Pont outfall, revealed that, of the 39 parameters checked, phenols (2-7 µg/L) and copper (3 of 10 samples; 9-12 µg/L) exceeded MOE guidelines. The benthic macroinvertebrate diversity was lowest immediately downstream of the Du Pont outfall. This reduction was coupled with an increase in both the density of Oligochaeta - a tolerant group and Manayunkia speciosa - an organism indicative of substrate and flow regime change. The benthic diversity reduction could be the result of turbulent outfall flow and/or chemical effects.

Over the complete study area, organic enrichment coupled with low level effects from industrial point sources influenced the benthic community dynamics. As an example, the absence of Bithynia tentaculata was indicative of local environmental stress areas.

Complete recovery of the benthos was evident well within the final downstream transect 4 km from the Du Pont outfall. In general, benthic macroinvertebrate species numbers have improved since the 1975 MOE biological survey.