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ANY OTHER BUSINESS

Riverine and sub-sea disposal of tailings and associated wastes from mining operations around the world: the need for detailed assessment and effective control

Submitted by Greenpeace International

SUMMARY

Executive summary:	Greenpeace International wishes to draw the attention of the Scientific Groups to the outline information on mine tailings disposal operations presented at the annex to this document, with a view to evaluating the need for more detailed assessment and effective control over such operations and communicating that need to other relevant fora for consideration
Action to be taken:	Paragraph 4
Related document:	LC 24/8

Introduction

1 The briefing document attached at the annex, prepared for Greenpeace International by Dr. Robert Moran of Michael-Moran Associates (Colorado, USA), provides background information on the nature of sub-sea (submarine) and riverine tailings disposal (STD) operations from a number of mines located around the world, and serves to illustrate the scale of such discharges, including the likely order of contaminant inputs which may be expected to occur as a result.

2 While recognizing that pipeline discharges and other land-based sources of marine pollution fall beyond the regulatory scope of the London Convention and Protocol, Greenpeace International is concerned that, as a result, tailings discharges may frequently fall beyond the scope of any effective international regulatory oversight and control, despite their clear potential to act as major contributors to coastal marine environments of contaminants of concern to the Convention and Protocol.

3 Noting the general obligation under the Convention and Protocol to address all sources of marine pollution, Greenpeace International therefore wishes to draw the attention of the Scientific Groups to these concerns, in the hope that the need for detailed assessment and effective control of sub-sea tailings discharges may be considered and, as appropriate, communicated to other relevant fora, including, for example, UNEP's Global Programme of Action for Protection of the Marine Environment from Land-Based Activities.

Action requested of the Scientific Groups

4 The Scientific Groups are invited to take note of the information provided and comment, as appropriate.

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ANNEX

MINING SUBMARINE TAILINGS DISPOSAL [STD] – SUMMARY CONCEPTS

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1 Problem Overview

1.1 Each year, billions of tons of mine wastes, predominantly tailings, are being discharged into ocean waters in many parts of the world. Metal mine tailings from terrestrial sites are well known to be chemically-reactive and not inert, as has been demonstrated, for example, through monitoring of ground waters in contact with similar mine wastes at the edges of saline lakes. Moreover, many such sub-sea (or submarine) tailings disposal (STD) or riverine tailings disposal operations occur in tropical and semi-tropical areas where ocean waters are warm, thus rendering the wastes potentially more chemically-reactive than comparable cold waters. Many of the commonly occurring heavy metal contaminants exhibit some bioavailability, in both dissolved and particulate form, to benthic marine organisms leading, in some cases, to bioaccumulation.

1.2 Disposal of mine tailings can occur continuously for decades *via* a pipeline discharging to a river or direct to the sea. Most often, such STD operations are conducted offshore of developing countries, by companies headquartered in developed countries. Such disposal methods would generally be politically unacceptable within the exclusive economic zones [EEZ] of those developed nations.

1.3 The majority of metal mining/mineral processing occurs on land with the tailings routinely disposed, at least in the first instance, to land-based impoundments. The fact that such wastes are widely recognized by regulators not to be chemically inert is demonstrated by the extensive monitoring and numerous versions of geochemical tests that such agencies require these wastes to undergo. Price (1997) discusses geochemical tests and related procedures that are routinely employed in Canada and much of North America to define the contaminants that are likely to be leached from mine wastes, including tailings. While these tests have several limitations, they nevertheless demonstrate that such tailings are expected to (and do) release contaminants into the environment when they interact with fresh waters.

1.4 Metal-rich mine tailings of similar composition are also released into marine environments, many of which are in tropical areas. Numerous references are available in the technical literature documenting the increased solubility of many metals and metalloids as salinity and water temperature both rise, as compared to their comparable solubilities in cold, fresh waters. For example, Plumlee, *et. al.* (2000) present relevant data from wastes dumped from the Marcopper operations at Marinduque, Philippines.

2 Waste Characterisation

2.1 Discharges from mineral processing facilities routinely contain combined contaminants from the following general sources:

- natural rock
- added process chemicals
- explosives

- fuels/oils and greases/antifreeze
- water treatment, sewage facilities, laboratories
- miscellaneous operations. Depending on the physical environment, many mines utilize significant quantities of herbicides, pesticides, and road de-icing compounds.

2.2 Most mines attempt to collect all such waste streams and combine them in the tailings, which are then disposed into rivers or the ocean. Tailings can have a wide range of pH conditions from strongly acid to strongly basic. Both chemical extremes favour the increased solubility of numerous metals and metalloids.

2.3 The crushed mineralized rock (i.e. see analyses in Slack, *et. al.* 2004a,b), together with explosive residues, generally contain measurable concentrations of the following natural constituents: aluminium, antimony, arsenic, barium, cadmium, copper, chromium, cobalt, iron, lead, manganese, mercury, molybdenum, nickel, rare earth elements, selenium, silver, thallium, tin, titanium, tungsten, vanadium, zinc, calcium, magnesium, sodium and potassium, silica, sulphide, sulphate, nitrate, ammonia, boron, phosphorus, fluoride, chloride, and natural radioactive constituents (uranium, thorium, potassium-40, gross alpha and beta, in general).

2.4 The added process chemicals often include complex organic compounds such as xanthates, kerosene, numerous acids, lime, cyanide and related breakdown compounds (metal-cyanide complexes, cyanate, thiocyanate), oils and greases.

3 STD Examples –Volumes of Tailings/Metals

3.1 Table 1 summarizes data on some of the locations, ores and tailings volumes of modern mines which utilize, or have used, marine or riverine tailings disposal. Two examples which illustrate the massive volumes of metal mine tailings presently being dumped into ocean environments are:

- <u>Batu Hijau, Indonesia</u>: **140,000 tons of tailings per day** (tpd) [Poling and Ellis (2002) state 160,000 tpd] into Senunu Bay, deposited 3km from the coast at a depth of about 108m, off island of Sumbawa. [equal to 43,800,000 tons per year]. Estimated mine life = 17 yrs.

- <u>Grasberg, Indonesia</u>: **238,000 tpd, average**; 1.0 billion tons of tails discharged from 1972 through 2005; estimate 3.0 billion tons will be deposited during life of mine. Site employs riverine disposal of tailings, which then flows to a shallow sea.

3.2 Detailed chemical analyses of tailings materials are normally not made public. For example, it has not been possible to find any detailed, publicly-available chemical analyses of tailings for either the Batu Hijau or Grasberg operations mentioned above. Nevertheless, on the basis of average tailings compositions (mg metals per kg tailings) from four copper mines in Arizona, U.S.A. (Pond, et. al., 2005), (see Table 2), it seems likely that the annual discharges to coastal waters of metals from mining operations on this scale will make a substantial contribution to contaminant levels in the local environment. Furthermore, mine tailings contain numerous metals and metalloids other than those identified in Table 2 [see list above], many of which are considered potentially toxic (in waters and sediments) and which are regulated in numerous countries.

Table 1: Summary of publicly available information on tailings disposal from some key mining operations around the world. [Modified from data in Poling and Ellis (2002), and Coumans (2001)]

Currently Operating	Status	Tailings Disposed [tons per day, TPD]	Ore/Plant
Cayeli Bakir, Turkey	1994 – present	2,000	Cu-Zn mill flotation
Lihir, PNG	1997 – present	3,500 (est. 89 M tons, total)	Au mill, CN
Batu Hijau, Indonesia	1999 – present	160,000	Cu-Au mill
Huasco Iron, Chile	1994 – present	3,000	Fe ore, pelletizing
Currently Proposed	Status	Tailings Disposed [tons per day, TPD]	Ore / Plant
Petaquilla, Panama	?	90,000	Cu-Au
Ramu, PNG	?	14,000	Ni-Co laterite (autoclave leach)
Tampakan, Philippines	?	50,000	Cu-Au
Namosi, Fiji	?	100,000	Cu-Au
Recently Closed	Status	Tailings Disposed [tons per day, TPD]	Ore/Plant
Misima, PNG	1990 – 2004	20,000	CN, autoclave
Minahasa, Indonesia	1996 – 2004	2,000—3,000 (2.8 M tons, total)	Au mill, roast, CN
Island Copper, BC, Canada	1971 – 1995	30,000—60,000	Cu-Mo-Au flotation
Kitsault Moly, BC, Canada	1980 – 1982	20,000	Mo flotation
Atlas, Cebu, Philippines	1971 – 1994	70,000—100,000	Cu flotation
Riverine/Coastal Marine	Status	Tailings Disposed [tons per day, TPD]	Ore/Plant
Toquepala-Cuajone, Peru	≈1960 – 1997	100,000	Cu-Mo-Se flot.
(production continues; new tailings impounded 1997; effluent continues to ocean)			
Marcopper, Marinduque, Phil.	1975 – 1991	(200 M tons total)	Cu-Au
Grasberg, Indonesia	1972 – present	238,000 avg. (est. 3.0 Billion tons during life of mine)	Cu-Au

Table 2: Concentration ranges for eight metals or metalloids in tailings from four copper mines in Arizona, USA [from data provided by Pond *et al.* (2005)]

Tailings element	Tailings Conc. Range (mg/kg or ppm)	
	Min.	Max.
Fe	19300	27300
Cu	650	1190
Zn	13	160
Cr	7.1	13
Ni	11	15
Se	1.5	2.9
As	1.7	6.2
Pb	3	16

3.3 Mine companies often argue that successful STD can be performed where outfalls are located in or near deep ocean waters, so that tailings will not contaminate the shallow shelf areas. Generally, however, monitoring is not performed by independent parties and is inadequate to verify that the tailings are actually permanently deposited in the deep environments.

4 Conclusions

Given the paucity of data on composition of tailings and associated wastes being routinely discharged from mining operations in many parts of the world, it is not currently possible to estimate total inputs of contaminants nor, therefore, to describe or predict the scale of impacts that such discharges may have. Indeed, this lack of data and international oversight is very much part of the issue to be resolved, such that the scale of the problem and the urgent need for far greater regulatory control are all too often overlooked. What we do know already, however, is sufficient to indicate substantial cause for concern relating to disposal of tailings to the marine environment.

APPENDIX

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