

Environmental Implication of Dumping Waste on Marine Ecosystem

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ABSTRACT

Based on law and government regulation of Republic of Indonesia dumping waste is prohibited. Law No. 32/2009 on the Protection and Management of Environment stated that any person prohibited from dumping deliberate wastes and/or materials to the environment without permission. However some activities on mining and exploration and production of petroleum as well as dredging of port pond activities at Indonesian marine ecosystem still conducted with permission from the Ministry of Environment. There are some potential impact of dumping wastes on marine ecosystem such as physical disturbance to sea bed, physical and chemical disturbance to water column, organism-level effects for example acute/chronic toxicity, effects on growth and reproduction, ecological/ecosystem level responses, and human resources use for example aesthetic effects. This paper will explain the activities of mining and exploration and production of petroleum at the Indonesian sea and potential effects on marine ecosystem such as sensitive area (coral reef, sea grass bed, mangrove ecosystem), migration of mammal sea, the area of capture fisheries, and transportation lane in the sea. The specific activities of mining is tailing wastes from gold mining, while exploration and production petroleum activities is dumping of drilling cutting, drilling fluid and drilling mud on the sea.

Keywords: dumping wastes, mining and petroleum activities, marine ecosystem

INTRODUCTION

Dumping is activities of throwing, placing and/or importing deliberate waste and/or materials in an amount, concentration, time and specific location with specific requirements to specific environment (Law No. 32/2009, on Protection and Management of the Environment). However, some activities on mining and exploration and production of oil activities at Indonesian marine ecosystem still conducted with permission from the Ministry of Environment. Permission/permit can obtain not only from Ministry of Environment but also from governor, or bupati (head of district)/mayor agree with their responsibility.

In Indonesia, there are three main activities in dumping waste to the sea, namely mining activities is submarine tailing dumping (discharge), dredging of port pond and dumping of drilling cutting and drilling mud of oil exploration and production activities at the sea. Especially for dumping of drilling cutting and drilling mud activities have done in Indonesian sea in several areas and must follow specific requirement of Ministry Environment's regulation.

As mentioned in abstracts, there are a lot of potential impact of dumping of tailing and oil activities on the sea as well as on marine ecosystem. Therefore dumping must be avoid the sensitive area such as turtle nesting, fish sanctuary, fish migration especially migration of tuna and marine mammal, and marine transportation lane. The potential effects associated with submarine dumping are physical disturbance on the sea bed and water column, geochemical and chemical effects, organisms level effect, ecological/ecosystem level response and human resource use (Rankin et al, 1977). While the effect of oil exploration and production on sea environment especially of offshore drilling have been considered: acutely or sub-lethal on sensitive organisms or ecosystem, bioaccumulation of heavy metal in marine organisms, burial of benthic organisms, increasing of turbidity of water column, and effects on marine biological community or human consumers of seafoods (Swan, Neff and Young, 1994). These effects will be described more specifically later.

Dumping Wastes in Indonesia

Dumping Wastes of Tailing

Dumping wastes of tailing mainly is gold mining, for example in North Sulawesi, south part of Papua (Timika) and south part of Sumbawa. In North Sulawesi gold mining already have been
are still going on. Gold mining in Papua is the
very large. While in Sumbawa based on the
tailing which can be put in the placement area



in the deep sea (125 m below sea surface) is 58.4 million dmt/year, the average is 160,000 dmt/day. In the table below shows the total tailing dumping during the year of 2007-2010.

Table 1. The amount of tailing which placement in deep sea

Year	Total Amount Placement Tailing (dmt/year)	Average daily placement (dmt/day)
2007	42,440,057	120,227
2008	34,308,314	98,587
2009	40,465,977	115,288
2010	43,459,868	136,658

Note: dmt (dry metric ton)

The chemical characteristic of liquid tailing consist of several heavy metal namely As, Cd, Cr, Cu, Pb, Zn, Hg, and Ni as well as non heavy metal is H₂S (sulfide). The maximum concentration of heavy metal and sulfide is showed in the Table 2 below.

Table 2. The maximum concentration of heavy and sulfide

No.	The concentration of dissolved heavy metal in liquid tailing	Maximum Concentration (mg/L)
1.	As	0.2
2.	Cd	0.09
3.	Cr	0.1
4.	Cu	1.0
5.	Pb	0.1
6.	Zn	2
7.	Hg	0.003
8.	Ni	0.5
9.	H ₂ S	0,1

Table 2 shows that in the liquid tailing there are several of heavy metal, and sulfide. Some heavy metal is toxic namely As, Cd, Cr, Pb, Hg while Cu, Zn, Ni is low toxicity. H₂S also toxic for aquatic organism. The report of gold company stated that the concentration of Cu and TSS relatively higher in the sea bed. However there is no upwelling in this area (Report on the Placement of Tailing in the Sea Bed, 2010).

The potential effects of submarine tailings dumping/discharge (Rankin, Miller, Petrovic, Zapf-Gilje, Davidson, Drysdale, van Zyl, 1997) as follow:

Physical Disturbance on Sea Bed: acute and chronic smothering of benthic habitat, catastrophic effects of sediment instability (turbidity currents, slope failure and sediment resuspension).

Physical and chemical effects on water column: increased turbidity, changes in ocean circulation patterns due to changes in bathymetry and density effects, increased bioavailability of metal, alterations in metal speciation and fate.

Geochemical Effects: increased concentration of dissolved metal in water, sediment and sediment interstitial water.

Organisms-level Effects: effects on microbial community of water column (plankton) or sea bed (benthics animal), acute and/or chronic toxicity, clogging of fish or invertebrate gills and invertebrate filtering appendages.

Ecological/Marine Ecosystem-level Response: deleterious effects on benthic and plankton community structure, effects on primary productivity, loss of rare organisms, reduced biodiversity and abundance of organisms

Human Resource Use: food source contamination (for example heavy metal contamination), interference with harvesting, tourism and recreation, aesthetic effects.

Dumping Wastes of Dredging Port Ponds

Report of Deputy of Management of the Waste of Hazardous and Toxic and Disposal (2011) stated that there were three activities of dredging of port/harbor pond namely Belawan Port, Bengkulu, and Port of PT Indocement Tunggul Prakarsa Tbk in Sub District Pulau Laut Utara, District Kota Batu, Province of South Kalimantan. The main activity of dredging mud from port pond, for example initially dredging in port pond of Belawan was 818,640 m³ (2010), while in 2011 was 1 166 583.30 m³ while for port maintenance dredging mud was 756,072 m³, so total volume of Bengkulu Port dredging mud about 515,500 m³ and



in Kota Batu was 60,000 m³. (Asistent Deputy for Verification of Management of Waste of Dangerous and Toxic, 2011).

The dumping of dredging mud have not in sensitive area such coral reef, seagrass bed and mangrove, as well as the area of fishery and area of capture fishery. The main effect of this activity is increasing of Total Suspended Solid (TSS), which caused decreasing of total productivity because of high turbidity and low of transparency and photosynthesis of phytoplankton disturbed.

Dumping Wastes of Oil Exploration and Production

The wastes of activities of oil exploration and production in offshore are drilling cutting, and drilling fluid which potential impact on surface of sea water, water column and sea bed. This year in 2013 is "Drilling Year" for Ministry of Energy of Mineral Resources, because a lot of drilling oil in the offshore of Indonesian Sea, especially in Java Sea (Madura North), Makassar Straits, Sea of South Chin, Timor Sea and Arafura Sea (South Papua). Drilling is needed to exploration and increase production of oil in Indonesia. However these activities will be impacted the marine ecosystem, physically, chemically and biologically as well as geologically. The main environmental impact from offshore drilling have been considered:

Acute toxic and sub lethal/sub chronis effect in sensitive organisms and ecosystem (such as ecosystem of coral reef, seagrass bed and mangrove)

Bioaccumulation of heavy metals especially toxic heavy metal in marine organisms to dangerous and toxic concentration for human consumption

Burial of benthic organisms, or modification of the benthic environment through changing sediment texture, affected to decrease of biodiversity and abundance of benthic organisms

Increasing turbidity of the water column, decreasing of transparency and decreasing of primary productivity of plankton

More widespread effects on marine biological communities (fish capture, sea mammal) or on human consumers of seafoods (Swan, Neff and Young, 1994).

In Indonesia, Ministry of Environment have the special requirement for dumping wastes permit such as modeling of drilling cutting and drilling mud, map of sensitive area and transportation lane, total concentration of heavy metal and TPH, the concentration of TTS < 20 ppm (in mixing zone around 500 m²) and bioassay test (LC₅₀ 96 Hour of sea organism namely tiger prawn/*Penaeus monodon*, LC₅₀< 30,000 ppm) (Asistent Deputy for Verification of Management of Waste of Dangerous and Toxic, 2011).

Law and Regulation of Dumping in Indonesia

Law/act, government regulation and convention of wastes dumping on the sea as follow:

1. Act No. 32/2009, concerning Protection and Management of the Environment
2. Act No. 32/2004, concerning Regional Government
3. Act No.1/1973, regarding Indonesian Continental Sea
4. Act No. 31/2004, concerning Fisheries
5. Act No. 17/2008, concerning Shipping
6. Government Regulation No. 19/1999, concerning Pollution Control and/or Sea Destruction
7. Government Regulation No. 12/2006, concerning Licensing Requirements and Procedures for Disposal of Wastes at the Sea
8. London Dumping Convention 1972, Protocol 1996

CONCLUSION

There are three main activities of dumping at the sea of Indonesia namely dumping/discharge of mining especially gold mining, dredging of port pond and dumping wastes of exploration and production of oil. The potential impact of dumping on the sea is to surface, water column and sea bed on physical, chemical, geochemical and biological will be occurred. In Indonesia the gold mining is the largest discharge/dumping on the sea, another is dumping of drill cutting and drill mud. Based on Indonesian regulation dumping is prohibited without any permit, however dumping on the sea still occurred in Indonesian offshore.

REFERENCES

Faculty of Agriculture-JICA, 2013. Study on Dumping Wastes from Exploration and Production Activities at Sea in Indonesia Prepared for JICA advisor for Ministry of Environment and Forestry. Repository University of Riau :ulture University in Cooperation with japan



- Ministry of Environment, 2011. Landasan Persyaratan dan Kajian Teknis Permen Dumping Limbah ke Laut. Asdep Verifikasi Pengelolaan Limbah B3, Deputi Bidang Pengelolaan B3, Limbah B3 dan Sampah. Jakarta.
- P.T. Newmont Nusa Tenggara, 2010. Laporan Penempatan Tailing di dasar Laut Triwulan Ketiga. Tidak dipublikasikan.
- Rankin, M, Millter T, Petrovic, S. & Zapt-Gilje R., Davidson, S, Drysdale, K, and Van Zyl D., 1997. Submarine tailings discharge: Optimizing the evaluation and monitoring process. Tailing and Mine Wastes'97. Proceeding of the Fourth International Conference on Tailings and Mine Wastes'97/Fort Collins/Colorado/USA/13-17 January 1997. A.A. Balkema/Rotterdam/Brookfield/1997. Pp 303-316
- Swan, J.M., Neff J.M., and Young P.C., 1994. Environmentimplications of offshore noil and gas development in Australia. The findings of an independent scientific review. APEA and ERDC. Christopher Becks Book. Queensland, 4007.

