**Microplastic in Marine Environment and Its Impact**

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**ABSTRACT**

This article was the result of a research of literature study sources and impact of microplastic in the marine environment. Plastic debris could make microplasric caused by ultraviolet and give some negative impact for marine environment. Plastic debris in marine environment has come from industrial and fishing activities (human activities). All of marine environment in the world has contaminated by microplastic, microplastic will give negative impact for marine biota, recent study inform that turtle and fish have high microplastic content in both them. plastics industries should take responsibility for the end-of-life oftheir products by introducing plastic recycling or upgrading programmers.

Keywords: Microplastic, marine environment, environment, plastic debris, plastics

**INTRODUCTION**

Environment has been degradation caused by industrial activities (Winarno *et al*., 2019;Wibowo & Syarifuddin, 2018; Rosanti, 2015; Rosanti, 2016). Environmental damage has attracted much attention from both of researchers and general public, plastic waste is therefore hazardous for the environment. Plastics are lightweight, synthetic or semi-synthetic organic polymers that are cheap, strong, corrosion-resistant and durable (Derraik, 2002; Wick *et al*., 2013), nobody knows how much time plastic waste to completely degrade in the marine environment. Many types of plastics in marine environment such as fishing nets, ropes and plastic bags, occur in the natural environment. It is estimated that 50% of plastic products, including utensils, plastic bags and packaging, are intended to be disposable (Hopewell *et al*., 2009; Rochman *et al*., 2013). Plastic production has continuous growth from 1950 until 2015 **(Fig 1)** (Plastics Europe Market Research Group, 2015).

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**Figure 1.** Plastic Production from 1950 until 2015

 Plastics has commonly used and abundant polymers are low-density polyethylene (LDPE), polyvinyl chloride (PVC), polystyrene (PS), high-density polyethylene (HDPE), polypropylene (PP) and polyethylene terephthalate (PET) are 90% total plastic production worldwide (Andrady, 2011). Plastic will give negative impact for environment and human health. As some study about plastics, these polymers are also the most commonly found plastics in the environment, especially in marine environment (Tokiwa *et al*., 2009). Microplastics is smaller plastic with size less than 5mm, have recently drawn attention because microplastics not only make their way into the marine environment but are also more easily ingested by marine organisms, it’s make microplastics may thus act as vectors for the chemical transfer of pollutants within the food chain (Thompson *et al*., 2009)

**Table 1**. Occurrence of plastic debris found in water bodies.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  **Location** | **Regions** | **Water****Bodies** | **Water** **Column** | **Debris load** | **Unit** | **Plastic Types** | **Plastic Sizes** | **Plastic (%)** | **Reference** |
| USA | Laurentian Great Lakes | Lake | Surface Water | 43000 | item/km2 | Macroplastic and microplastic | 0.355–0.999 mm (81%), 1.000–4.749 mm (17%), N4.75 mm (2%) | 90 | (Wilson *et al.*, 2013) |
| Pacific Ocean | North Pacific  | Marine | Surface Water | 334271 | item/km2 | Macroplastic and microplastic | 0.355 to <4.76mm | 98% | (Mallory, Roberston, & Moenting, 2006) |
|  | Australia | Marine | Surface water | 4256.4 | item/km2 | Macroplastic and microplastic | 0.4 to 82.6mm | 80% | (Revelles, Cardona, Aguilar, & Fernández, 2007) |
|  | NE Pacific | Marine  | Surface water | 8–9180 | Item/m3 | Microplastics | 64.8 μm to 5810 μm | 75% | (Revelles *et al*., 2007) |
|  | Geoje Island | Marine | Surface water | 16000 | Item/m3 | Microplastics | b50 μmto N1000 μm | - | (Song *et al*., 2014) |
| Mediterranean Sea | North pacific Central Gyre | Marine | Surface Water | 334.27 | item/km2 | Macroplastic and microplastic | 0.355 to N4.76 mm | 98% | (Moore, 2008) |
|  | Tokyo Bay  | Marine | Surface water | 1.9–3.4 | Items/Ha | No information | No information | 48.3–58.9% | (Kuriyama et al, 2011) |
|  | Eastern China | Marine | Seafloor  | No information | Items/Ha | No information | No information | <5% | (Lee *et al*., 2006) |
|  | South Sea of Korea | Marine | Seafloor |  | Items/Ha | No information | No information | <10% | (Lee, Cho, & Jeong, 2006) |

**PLASTIC SOURCE**

Plastic debris in marine environment has contributed by land, plastic debris in land has caused by industrial areas, plastic bag usage, plastic bottle, solid waste disposal and human activities around beach and water bodies. Industrial activities, fishing activities will production plastic waste and give an impact for marine ecosystem **(Fig. 1)**. 80% plastic debris in marine environment come from land (Derraik, 2002; Rosarina and Laksanawati, 2018) and 20% come from commercial fishing. Fishing activities an estimated 640,000 tons of plastic debris are added into the ocean every year, it’s totally 10% of the total marine debris (Good *et al.,* 2010).



**Figure 2.** Pathways of plastic debris transportation in marine ecosystem

**Effect on Organisms**

Macro and microplastics are hazardous material to organisms (Good et al., 2010). The effects of macroplastics and microplastics include blockage of the intestinal tract, inhibition of gastric enzyme secretion, reduced feeding stimuli, failure to reproduce, decreased steroid hormone levels and delays in ovulation (Azzarello & Van Vleet, 2007). Microplastic has produced by degradation of plastic caused by ultraviolet (UV) radiation **(Fig. 3)** and because UV light is absorbed rapidly by water, plastics generally take much longer to degrade at sea than on land (Bergmann, 2009)



**Figure 3.** Properties changes of microplastics after degradation by UV

⁠ Microplastics has been a problem for world environment especially on marine environment, majority ocean in the world has been contaminated microplastics **(Fig. 4)**. Microplastic will give physical impact for environment including internal and/or external abrasions and ulcers; and blockages of the digestive tract, which can result in satiation, starvation and physical deterioration. In turn this can lead to reduced reproductive fitness, drowning, diminished predator avoidance, impairment of feeding ability, the potential transfer of damaging toxicants from seawater and ultimately death **(**Wright *et al.*, 2013;Gregory, 2009). Microplastics ingestion for many organism can see in **Table 2**.

**Table 2.** Plastics ingestion in marine organism

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Organisms** | **Number of samples** | **Location** | **Ingested materials** | **Plastic Sizes** | **Reference** |
| Turtle | 265 | Brazilian coast | No information | No information |  (Santos *et al.*, 2015) |
|  | 20 | Ubatuta | Soft plastic (54.3%), hard plastic (19%), nylon (21.4%), rubber (4.2%) and foam (1.1%) | (76%) 0–5 cm, (23%) 5–10 cm, (1%) >10 cm | (da Silva *et al*., 2015) |
|  | 76 | Paranagua | Plastic bags (44.7%), hard plastic (38.5%), nylon (7.73%), polystyrene (5.1%) and rubber (1.1%) | No information | (Guebert-Bartholo *et al.,* 2011) |
| Fish | 566 | North Sea | No information | 0.4mm to 4.48mm | (Foekema et al., 2013) |
|  | 504 | English Channel | Semi synthetic cellulosic material rayon (58%), and polyamide (35%) | 0.13 mm to 14.3 mm | (Lusher *et al.*, 2013) |

**Conclusion and Future Research Direction**

Microplastics are problem for everyone in the world, this problem will give some negative impact for environment and human health. Microplastic has been growing every single years, 80% plastic debris has come from land and 20% from fishing activities. Microplastic is degradation material caused by UV and made any problems for marine ecosystem especially biota. Recomendation for future research direction is researcher should make bio-plastic that easy to reduce by nature. This problems need support by all of sector include regulation for limited plastic usage.

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