NOWPAP MERRAC

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Marine Environmental Emergency Preparedness and Response
Regional Activity Centre

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Best Practices in dealing with Marine Litter in Fisheries, Aquaculture and Shipping sectors in the NOWPAP region

Regional Seas

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Chapter 1. Introduction

Marine litter has been defined as any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment, including all materials discarded into the sea, on the shore, or brought indirectly to the sea by rivers, sewage, storm water, waves, or winds (UNEP, 2011).

A significant proportion of marine litter originates from merchant shipping, ferries and cruise liners, fishing vessels, military fleets and research vessels, pleasure craft, offshore oil and gas platforms, aquaculture installations and waterway recreational activities including diving and marinas (UNEP, 2005). This marine litter gives rise to a wide range of negative environmental, social and economic impacts causing direct or indirect damage to marine ecosystems as well as human activities and properties such as fishing and aquaculture, shipping, tourism and recreational activities (MERRAC, 2013).

The Northwest Pacific Action Plan (NOWPAP) is addressing the problem of marine litter through the implementation of a Regional Action Plan on Marine Litter (RAP MALI), which has been implemented since 2008 as a major outcome of the two-year project called the NOWPAP Marine Litter Activity (MALITA). Under the NOWPAP RAP MALI, the NOWPAP members have been encouraged to implement actions to prevent, monitor and remove marine litter at national and local levels.

There are many measures and methods for marine litter management being implemented by the NOWPAP members and sharing the best practices of marine litter management will help to reduce the amounts of marine litter and strengthen actions against marine litter. In this regard, the best practices on collection, disposal, research and development, and policy-based management in dealing with marine litter in fisheries, aquaculture and shipping sectors in the NOWPAP region were examined and compiled in this report. Some of the practices presented in this report have been introduced in the previous MERRAC reports but more detailed information and improvements of the methods have been added in this report.

Chapter 2. Efficient Collection System

There is a significant portion of marine litter created in the process of fishing activities such as abandoned, lost or otherwise discarded fishing gear (ALDFG) which causes entrapment and entanglement of animals giving numerous negative impacts to the marine environment and fishing activities (UNEP, 2011). In view of the seriousness of these sea-based marine litters in Korea, the Ministry of Oceans and Fisheries (MOF, former Ministry of Land, Transport and Marine Affairs) of the Government of Korea has introduced three collection programs to prevent dumping and to effectively collect marine debris derived from fishing activities.

2.1. Buy Back Program

When fishermen pull up marine litter such as fishing nets and hooks during their fishing activities, they generally toss them again overboard, mainly due to uselessness and the difficulties of storing onboard before unloading them to the appropriate port reception and treatment facilities for treatment and disposal. As a result, most of the marine litter hauled during the fishing activities is dumped, which causes many problems such as habitat destruction, ghost fishing, and threatening navigation of vessels, etc.

Buy Back program, known as “Purchase Program” was implemented by the Government of Korea with the main goal to prevent dumping of marine litter lifted onboard in the process of fishing activities by encouraging fishermen to bring back the marine litter collected during their fishing activities. The key element of the Buy Back program is to provide fishermen economic incentives for marine litter removal and collection (Fig. 1).

Figure 1. ***The collected litter in the distributed garbage bags (MERRAC, 2012).***

The program has been successfully implemented in Korea since 2003. Following the first successful case of Incheon City (MERRAC, 2008), the Government of Korea has expanded the Buy Back program into 12 major ports in Korea and the funds for the implementation of this program were from the central government (60%) and the local government (40%).

In the 1st National Basic Plan of Marine Litter Management in 2009 (MOF, 2008), the Government of Korea decided to include the Buy Back program as an integral part of the Plan, aiming to consolidate the capacity-building of removal and treatment of marine litter. According to the 1st National Basic Plan, marine litter voluntarily brought by fishermen can be purchased by the local government at the designated ports for its treatment.

Three types of marine litter are classified in the Buy Back program: general fishing nets and ropes; fishing traps; and abandoned or lost polystyrene (generally known as “styroform” named by a brand name). During the first year of the 1st National

Basic Plan, the purchasing price for abandoned or lost fishing nets or ropes was set up at USD 3.8 (KRW 4,000) per sack (40 L) and lost polystyrene by USD 0.24 (KRW 260) per kg. Other fishing gear such as fishing trap which are inappropriate to calculate the price by volume or weight was counted per unit. For example, the traps for blue crab fishing in the Yellow Sea were purchased at USD 0.23 (KRW 250) per trap (MERRAC, 2012).

Since the 1st National Basic Plan was introduced, the Buy Back program has produced considerable benefits. According to the statistics conducted by government, the total amount purchased between 2009 and 2012 reached 30,959 tons. During the same period, the total investments combined by the central and local governments reached USD 20 million (KRW 22,529 million). The removal cost during this period was USD 678 (KRW 728,000) per ton, while, the removal cost in 2003-2007 was USD 714 (KRW 766,000) per ton.

The Buy Back program enabled the Government of Korea to save the budget for marine litter removal by USD 36 (KRW 38,000) per ton and besides, improved the efficiency of marine litter removal activities. Furthermore, from the perspective of the efficiency of fishing grounds' management, it was evident that the benefit of Buy Back program was greater than that of the economic values.

The Buy Back program has been successfully implemented but there are still few improvements to be made. One of the main concerns is "illegal actions of fishermen" where fishermen intentionally increase the volume and weight of marine litter in order to be paid more, by way of mixing the lifted marine litter with general garbage coming from their daily life.

Through the 2nd National Basic Plan (MOF, 2013) which is initiated from 2014, the Government of Korea is trying to strengthen the management of the program by checking the purchase regulations to prevent the inappropriate behaviors of fishermen. Also, as part of the 2nd National Basic Plan, the government is planning to increase the number of the collection sites from 60 in 2014 to 80 in 2018.

2.2. Marine Litter Collection by Floating Receptacles

The program “Marine Litter Collection by Floating Receptacles (Deck Barges)”, is one of many action plans focusing on the minimization of sea-based marine litter discharge including solid waste (e.g. wires and tires), lost cargo, and ALDFG in Korea. The main goal of the program is to improve the effectiveness of sea-based marine litter collection and treatment by installing and operating deck barges in vicinity of ports and harbors.

Before the 1st National Basic Plan of Marine Litter Management launched in 2009, the Government of Korea did not provide enough marine litter reception and treatment facilities. Among 2,306 ports and harbors in Korea, 77 ports had waste reception facilities, which accounted for only 3 percent of total number of ports. Lack of marine litter reception facilities made the treatment process—a next phase of the reception—harder and resulted in many problems in implementing national marine litter management efforts in Korea.

Theoretically, responsibility of the treatment of ALDFG should be up to its users. However, in the case of accumulated benthic marine litter already abandoned and/or lost during the fishing activities, it is impossible to identify or trace the polluters or users. As a result, and in practice, the costs for the collection and treatment has been burdened by national and/or local government.

Laying out the 1st National Basic Plan in 2008, the Government of Korea, especially, the Ministry of Oceans and Fisheries (MOF) introduced the deck barge program as a main tool to facilitate marine litter collection process, and to invite fishermen to use the collection facility (Fig. 2). The program aims for “minimization of marine litter discharge,” which is one of the four main pillars of governmental strategy for marine litter.

Figure 2. ***Floating receptacles in Haenam, Republic of Korea, 2009 (Provided by MOF).***

One of the main strengths of the deck barge-type collection facilities is that such a facility does not require high construction cost as needed for the on-land facilities driven by expensive land-prices.

On the other hand, the deck barge installing sites should be carefully selected by predefined standards, to maintain the facility in safe and optimal ways: safe from possible damages caused by severe weather conditions such as typhoons and storms, accessible without troubling navigation of vessels, and proper distance from ports and harbors.

During the 1st years of its implementation, the total expense of the project executed in the period of 2010-2012 reached USD 3.7 million (KRW 4,184 million), surpassing the originally allotted funds of USD 0.57 million (KRW 614 million) in 2008. As a result, 128 deck barges have been newly installed across the country, which can be interpreted that, in governmental (both national and local) level, the program has been implemented actively and eagerly. The funds for covering the costs of the installments were equally provided by both national (the Fisheries Development Fund run by the Ministry of Agriculture, Food and Rural Affairs) and local governments. Local governments' investment by 50% of the total expense needed for installment has led the local government to have an ownership over the deck barges and to a relatively good level of maintenance

According to the 2nd National Basic Plan (2014-2018) of Marine Litter Management, the Government of Korea is planning to expand the installation sites from 179 in 2013 to 254 in 2018 equipped with reception facilities and diversifying the types of the deck barges from two to four by 2016. The installation of the collection facilities will be implemented mainly in the urbanized fishing villages or preferentially in regions where the land purchase to build on-land facilities is relatively too high.

2.3. Clean Fishery Communities Program

Fishing activities and fishery production activities generally create a variety of marine litter. One of the most common types of marine litter resulted from fishing activities is ALDFG. Unsustainable practice of fishery production can also be source of sea-based marine litter such as plastic bottles, aluminum cans, plastic bags and other containers, metal or plastic bottle caps, and leftover food waste and waste water. Dumping this kind of smaller general garbage, emitted during fishery-related activities, is illegal though can hardly be regulated. All wastes have caused serious problems for maintaining sustainability of the marine environment such as healthy oceans in general, or healthy fishing grounds in particular, while threatening marine wildlife, marine ecosystems, and more broadly speaking, healthy fishery community life itself.

The management of the marine litter by fishery communities was regulated by enforcement system and/or regulation of relevant authority such as Korean Coast Guard (KCG) in Korea. From the mid-2000, the Government of Korea including KCG began to shift methods from the regulator enforcement-based approach to volunteer-based approaches, by concentrating on more policy implementation programs such as "Clean Fishery Communities Program".

The "Clean Fishery Communities Program" was originated from the "Bringing Back of General Garbage Campaign" and "Bilge Water Collection Campaign" (Fig. 3). The

“Bringing Back of General Garbage Campaign", which encourages fishermen to bring their general garbage back to small-size litter installments onshore, not by rules, but by their volunteerism, was introduced in 2006 by KCG. In order to maximize fishermen’s volunteerism, KCG, in 2007, installed a total of 60 reception sites along the entire coasts of Korea. The number of the sites continued to increase from 100 in 2011 to 122 in 2012. When adopted as one of the action plans focusing on the minimization of sea-based marine litter in the 1st National Basic Plan of Marine Litter Management started in 2009, the main motivation of this Bringing Back Garbage Campaign was to protect small fisheries areas by reducing fishermen’s economic burden.

In 2010, another component was included, with the main objective to improve the capacity for collection of bilge water used in small fishing vessels (smaller than 10 ton). By combining the collection activity of the bilge water together with the Bringing Back of General Garbage Campaigns, the Government of Korea introduced a broader and more comprehensive campaign program, entitled “Clean Fishery Communities Program”. In the following year, governmental agencies at various levels, including the MOF, KCG, Korea Marine Environment Management Corporation (KOEM), and National Federation of Fisheries Cooperatives (NFFC) jointly signed the Memorandum of Understanding (MoU) for the implementation of the program, aiming to set up roles and responsibilities of participating organizations.

Figure 3. ***The combined “Clean Fishery Communities Program.***

Upon signing of the MoU, Clean Fishery Communities Program is jointly implemented by KCG, MOF, KOEM, KFFC and local governments. First, KCG presides over the efforts of selecting and installing small-scale marine litter collection equipment at ports and harbors. Second, the MOF and KOEM facilitate collection and treatment of the bilge water. Third, KFFC supports purchasing costs of the collection equipment and payments for Green Supporters' volunteering activities. And lastly, the local governments are assigned to support treatments and recycling of the general garbage brought back by fishermen.

The "Clean Fishery Communities" program seems to be promising. In 2008, the total volume of the removed general garbage from fishing vessels through the Bringing Back campaign was merely 309 tons but the number reached 1,372 tons in 2012, which was 4 times of that in 2008. Furthermore, collection of bilge water showed a record-breaking increase from merely 10 tons in 2010 to 128 tons in 2012. The statistics showed that the harmonization of the encouragements from the public sector which was the central government agencies, and the volunteerism of the fishermen representing the private sector, has made the approach more effective than when the enforcement-centered policy tools were implemented in the past.

In order to boost the success of this campaign, the incentive-based public campaigns and outreach programs have been introduced. For example, the Bringing Back of General Garbage Campaign has been followed by reward grants to the best practice implemented in collaboration with Korea Fisheries Infrastructure Promotion Association. Such rewards include financial support for purchasing and installing garbage classification equipment for relevant fishery community, exchanging old ones to the new ones, and giving direct cash prizes to the selected exemplary individuals and fishery communities. In 2012, 8 fishery communities were awarded individually with USD 19,300 (KRW 20 million) for their best practice. In 2013, the number of the awarded communities was 16, with increased contenders from 43 in 2012 to 117 in 2013. According to the 2nd National Marine Litter Management Plan of the Government of Korea, the number of the awarded communities will be increased to 240 by 2018.

Chapter 3. Environmental-Friendly Disposal Techniques

3.1. Compacting Expanded Polystyrene (EPS) Floats by Portable Compressor

1) Recycling System for Waste EPS Floats

EPS floats are used widely for various aquaculture operations in coastal areas such as net cage rafts and oyster farming rafts. If these floats are not well maintained and left exposed to the elements of weather and other physical abrasions, they disintegrate into smaller pieces and scatter along the beaches (Fig. 4).

Figure 4. ***Scattering EPS fragments on the sea surface after typhoon at harbor (Left) and near the aquaculture ground (Right).***

Fujieda et. al. (2006) surveyed the density of foamed plastic fragments washed up along 30 beaches in Japan from 2004 to 2006 and the Japan Foam Styrene Industry Association tallied the production volume of the EPS float by prefecture in 2005 (Fig. 5). Among the annual production of EPS in 2011 which accounted for 150,000 tons, the fish containers constituted 56% of the total production (Japan Expanded Polystyrene Association (http://www.jepsa.jp/recycle/achievements.html)). The annual production of EPS float was 500 tons (155,000 floats), making 0.3% of total EPS products (Umi to Nagisa Kankyō Bika Suishin Kikō 2005b).

According to the results shown in Fig. 5, both the density and volume of EPS floats are greater in the western part than the eastern part of Japan. The density of foamed plastic fragments has a direct relationship with the volume of the EPS floats production and use. For examples, in Seto Inland Sea and south Kyushu area, the EPS floats are highly produced and used, and the foamed plastic fragments are highly scattered along the beaches in the area. These EPS floats are used for net cages for aquaculture in Kyushu and rafts for oyster farming in Seto Inland Sea. On the other hand, although there is no production and use of the EPS floats, the area showing the highest density of the EPS fragments was the island coast of the northern Kyushu. It has been doubted that the EPS fragments are originated from the disintegration of EPS floats in oyster farming in the neighboring countries.

Fujieda et.al (2002) has investigated on the small plastic fragments along the coast of south Kyushu since 1998. The foamed plastic fragments accounted for 92.6 % of the total small plastic debris and the dominant size ranged from 0.3 to 4.0 mm (Fig. 6).

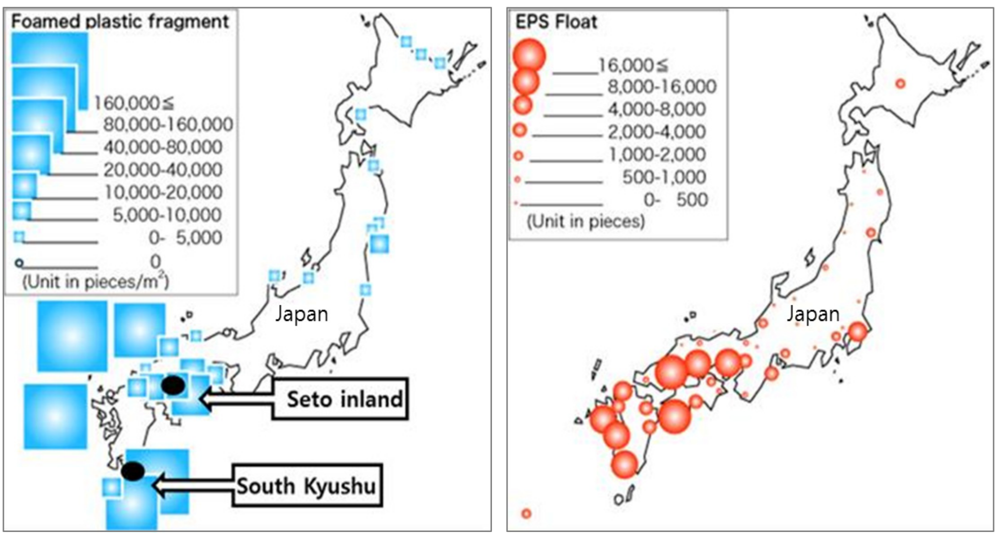


Figure 5. ***Density of foamed plastic fragments (Left) (Fujieda et. al., 2006) and production volume of EPS float by prefecture in Japan (Right) (Umi to Nagisa Kankyō Bika Suishin Kikō 2005b).***

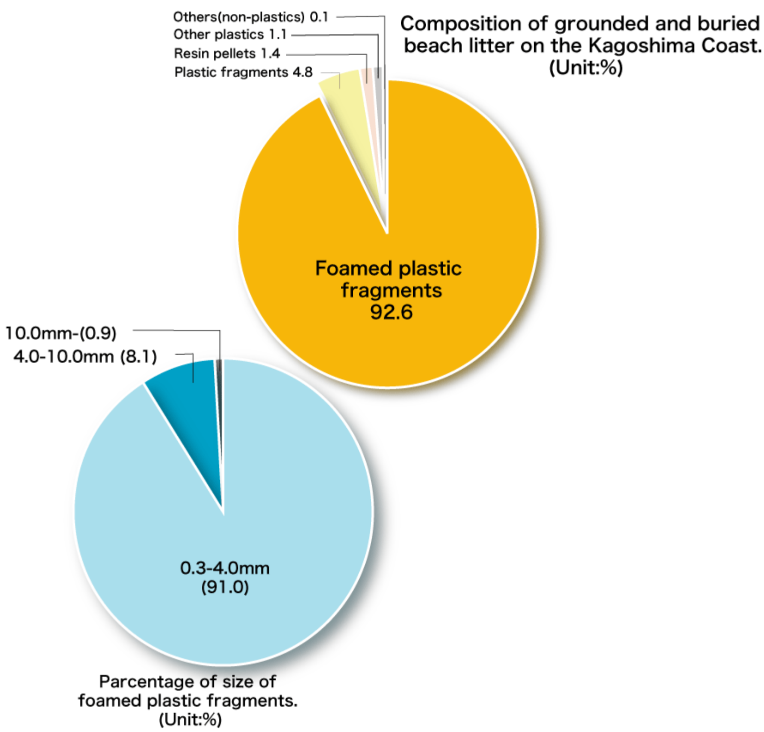


Figure 6. ***Composition of grounded and buried small plastic fragments along the coastline of South Kyushu (Unit %) (Fujieda et.al., 2002).***

In addition, Fujieda et.al (2000) visually assessed the use of EPS floats in Kagoshima Bay in 2000 (Fig. 7). In general, a total of 3,048 EPS floats without covers were washed up along the coast of Kagoshima Bay and these floats dominated areas along the east coast of the Bay. In the most places these floats are used as fenders in harbors. Also, according to Figure 8, along the entire coastline of South Kyushu; the East Coast of Kagoshima Bay, which is the major aquaculture area in the bay, was highly dominated by foamed plastic fragments and it had a maximum density of about 70,000 pieces/m^2 (Fujieda et. al., 2002).

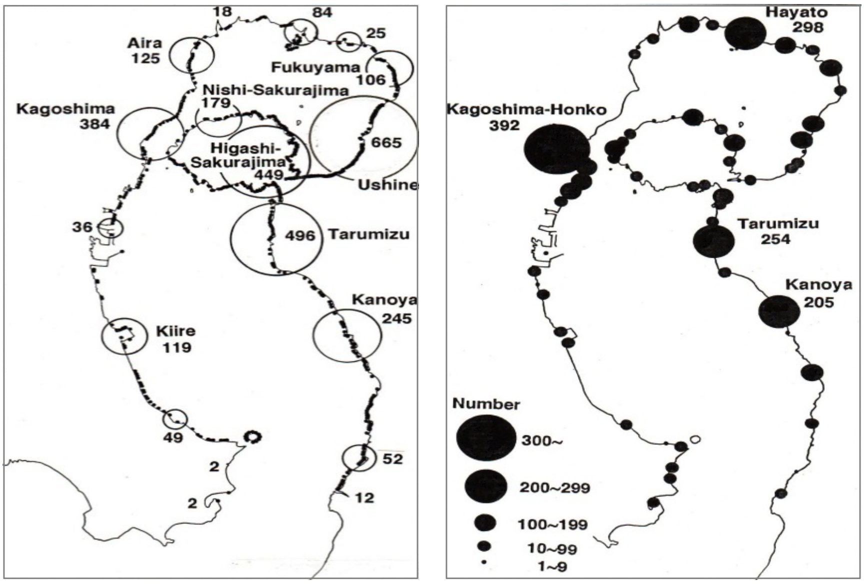


Figure 7. ***Grounded points of EPS floats (●) and the number of the EPS floats in fishing district (○) (Left) and distribution of EPS floats (●) without covers used on the sea as the fender or mooring buoy (Right) in Kagoshima Bay (Fujieda et. al., 2000).***

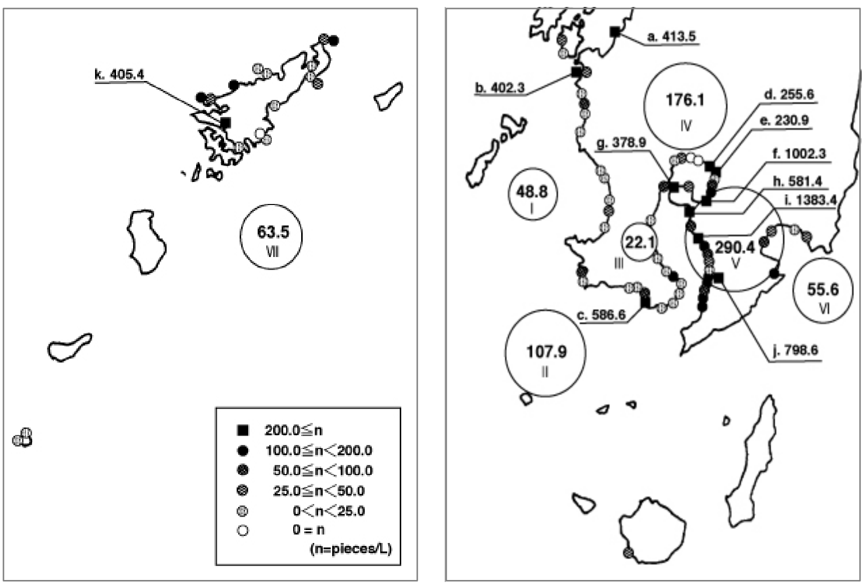


Figure 8. ***Distribution of foamed-plastic fragments in the unit of density along the coastline of South Kyushu (Fujieda et. al., 2002).***

Formed plastic debris is also one of the most common items in the Seto Inland Sea (Fujieda, 2011). The EPS floats are commonly used as floats for the oyster farming rafts in Hiroshima Bay. Both density of the EPS fragments and amount of the floats without covers were greater than Kagoshima Bay (Fig. 9).

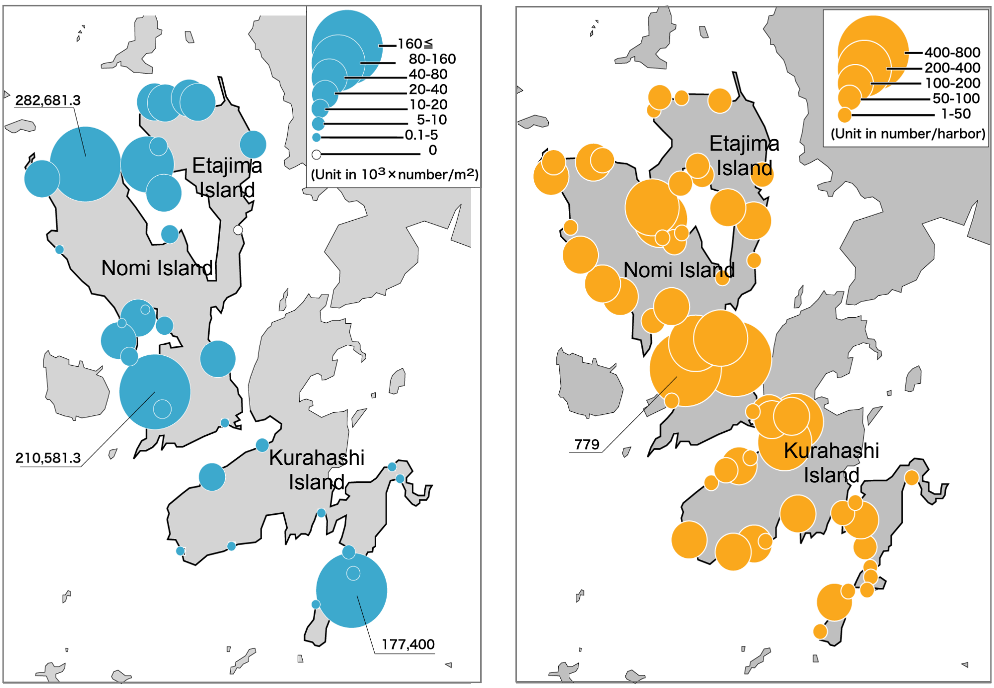


Figure 9. ***Density of the formed plastic fragments (Left) and amount of the EPS floats using as fender or buoy without covers (Right) around Etajima island in Hiroshima bay (Fujieda and Sasaki, 2005).***

The source of EPS fragments was mainly estimated to be out of the EPS floats and as a result, the Government of Japan decided to reduce the amount of EPS floats usage in the sea. In addition, it was also very important to correctly treat the used EPS floats.

The floats are one of the most difficult items to dispose because of their big volume and higher burning calories and besides, it is difficult to stock on land for temporal storage because of the higher risk for fire. While the stocked EPS floats can easily be repaired by being wrapped with new covers and be repeatedly used, these repaired EPS floats can degrade into smaller fragments when inappropriately reused like fenders of boats in the harbor as the cover degrades very quickly in the sunlight. As a result, the Government of Japan made efforts in introducing new EPS float treatment systems to respond to such problems.

In 2011, about 85.7 % of total EPS production was recycled which was the highest rate in all plastics in Japan. There are over 133 recycling stations in Japan but they are generally for the daily use items which mean that the high amounts of EPS float which had not gone through proper disposal and recycling system are washed up on the coasts of Japan.

The annual production of EPS float is 500 tons (155,000 floats). The number of the fish farming companies in Japan is decreasing and as a result, waste EPS floats are discarded and they are increasing around the fishing grounds. Where the incineration of EPS floats is prohibited by regulation it has become harder to control and reduce the fragmentation of the EPS floats in Japan and as a result, economical disposal or recycling of the floats was needed.

The improved recycling system for EPS floats treatment started as part of the government program from 2003. The basic method is that the wasted EPS floats are compressed with a portable compressor at the fishing port near the marine culture area. Figure 10 shows the new portable compressor of EPS floats (STYROS-BUOY, ELCOM Co. Ltd.; http://elcom-jp.com/products/). The machine opening is made wide for the king size buoys that are often used as the floats of the aquaculture rafts. The mechanism of this compressor is that, the EPS float is crushed or broken down into small pieces through the crushing zone, and compressed through a screw press.

The volume of the EPS decreases as the gas-containing cells shrink while the polystyrene softens by the friction/distortion heat. Bad odors are hardly generated because the polystyrene resin does not reach high temperatures and further, the polystyrene resin does not decrease molecular weight because heating is below the decomposition temperature. Hence, the material processed with this device can be recycled as foam plastic. This compressor has a simple structure with few parts and the maintenance and management is easy.

Figure 10. ***The portable compressor for EPS floats (STYROS BUOY, ELCOM Co. Ltd.)***

A demonstration of the portable compressor was carried out in Saiki city (Ohita prefecture), Etajima city (Hiroshima prefecture), Mianamiise town (Mie prefecture), Sasebo city (Nagasuki prefecture), Ojika Island (Nagasaki prefecture), Nagashimatown (Kagoshima prefecture) and Amakusa city (Kumamoto prefecture) from 2009 to 2012. These demonstrations were mainly carried by the waste generators (fishermen) of the EPS floats.

About 44,871 waste EPS floats were processed from 2003 to 2007 (1^{st} term) and 2010 to 2012 (2^{nd} term) (Table 1.) (Umi to Nagisa Kankyō Bika Suishin Kikō 2004, 2005a, 2005b, 2007, Marino Forum 21 and Umi to Nagisa Kankyō Bika Suishin Kikō 2008, Marino Forum 21, Umi to Nagisa Kankyō Bika Suishin Kikō and Tokyo Kyuei 2011). The machine had a compacting ratio for floats of $1/5^{th}$-$1/25^{th}$ and a compressing capacity of 50-100 kg/h (14-16 m^3/h) in this trial.

Table 1. ***Processing results of waste EPS floats from 2003 to 2012.***

Year	Location	Processed weight (kg)	EPS float number	Memo
2003	Uwajima (Ehime Prefecture)	1,088	240	
	Kokubu (Kagoshima Prefecture)	5,640	1,343	*
2004	Amakusa (Kumamoto Prefecture)	8,360	1,990	*
	Ushine (Kagoshima Prefecture)	7,350	1,751	*
	Nishisakurajima (Kagoshima Prefecture)	1,390	331	*
2005	Uwajima (Ehime Prefecture)	21,130	5,031	*
	Ushine (Kagoshima Prefecture)	12,470	2,969	*
	Azumachou (Kaghoshima Prefecture)	19,760	4,705	*
2006	Uwajima (Ehime Prefecture)	18,870	4,492	*
	Ushine (Kagoshima Prefecture)	5,290	1,259	*
	Azumachou (Kaghoshima Prefecture)	8,270	1,968	*
2007	Azumachou (Kaghoshima Prefecture)	8,990	2,279	
2010	Minamiise (Mie Prefecture)	11,480	3,021	
	Saeki (Ohita Prefecture)	12,460	3,279	
	Sasebo (Nagasaki Prefecture)	6,450	1,696	
2011	Etajima (Hiroshima Prefecture)	3,000	666	4.5 kg/float
	Sasebo (Nagasaki Prefecture)	2,300	680	
	Nagashima (Kagoshima Prefecture)	8,761	2,190	
2012	Sasebo (Nagasaki Prefecture)	3,780	945	
	Ojika Island(Nagasaki Prefecture)	1,600	400	Drifted floats
	Amakusa (Kumamoto Prefecture)	2,430	607	
	Nagashima (Kagoshima Prefecture)	12,114	3,029	
Total		182,983	44,871	

* Weight estimated by 4.2 kg/float

Processed discarded floats were recycled to RPF (Refused Paper and Plastic Fuel), which is one of the solid fuels that combines waste paper (low calorie item) and plastic (high calorie item). This solid fuel is used for heat recovery as recycled fuel for the paper company's boiler instead of coal. Hereunder are the 4 methods (Fig. 11) carried out for EPS disposal from the storage space of discarded EPS floats to the recycle plant of industrial waste disposal:

- Case 1: Outsource the transportation and disposal of discarded EPS floats to the hauler/transporter and bringing them to the recycle plant (Industrial waste disposal). The EPS user covers all the costs.
- Case 2: Use a portable compressor for EPS floats. The EPS floats user brings the discarded EPS floats to a stockyard used for volume reduction before disposal. The volume reduction works are carried out by the user of the EPS floats. Later the transporter collects the volume reduced EPS and takes it to the recycle plant.
- Case 3: Use a rented portable compressor for EPS floats. The EPS floats user brings the discarded EPS floats to a stockyard used for volume reduction before disposal. The volume reduction works are carried out by the user of EPS floats. Later the transporter collects the volume reduced EPS and takes it to the recycle plant.
- Case 4: Directly transport the non-volume reduced EPS floats to the industrial waste disposal plant by the user.

In the second period from 2010 to 2012, an economical disposal and recycling method for the wasted EPS floats was developed. As a result of the analysis (Fig. 12), the most economical method was found to be the case (4) and it costs approximately USD 3 (JPY 300) per float. However, this method is confined to the case where the recycle plant is located near the aquaculture ground and the case is limited to only two areas in Japan. The second lowest cost is the case (3), where the cost can get decreased to USD 3 (JPY 300) per float if over 3,000 floats are processed at a time. However this method is also confined to the case where the rental agency is near the aquaculture ground. If the processing is over 10,000 floats/time, the cost of the case (2) can be the lowest. However, there is no user or area that processes floats over 10,000/time. The highest cost method appeared to be the case (1). The hauling/transportation cost accounts for a half of the total cost.

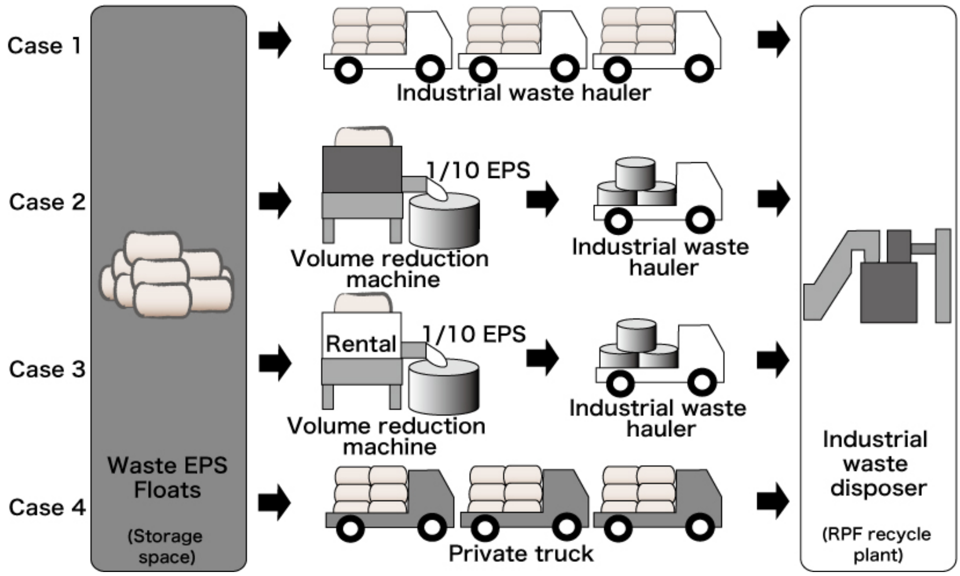


Figure 11. ***The four methods of disposals of waste EPS floats-the routes from the storage space to the recycle plant of industrial waste disposal.***

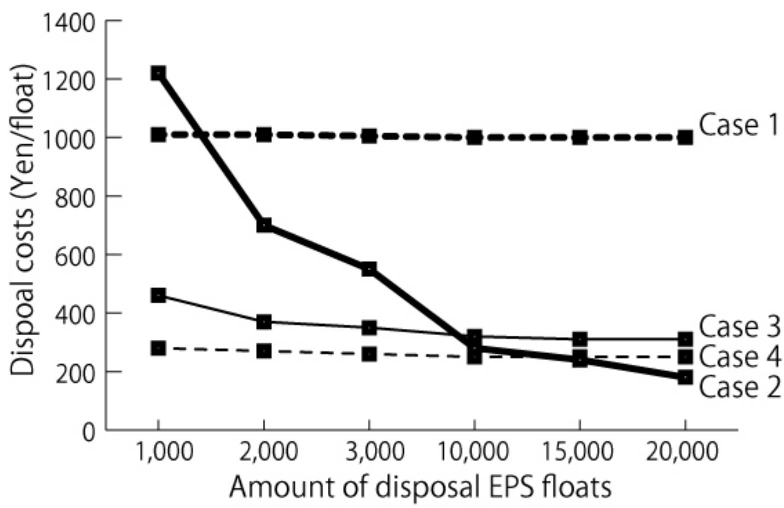


Figure 12. ***Comparison of disposal costs according to the disposal methods (Marino Forum 21, Umi to Nagisa Kankyō Bika Suishin Kikō and Tokyo Kyuei 2011) (Refer to Fig. 12 for each case).***

By taking everything into consideration, the best effect can be produced if the local government or an extended association buys a volume reduction machine and sequentially leases it to the areas where over 2,000 floats are stocked. The floats-users of those areas make their own initiatives and reduce the volume of their own floats. Currently, every local government or the Fisheries Cooperative Association has a machine and they are using it on site.

During the last several years, RPF has been processed from the EPS floats. However there was an issue that if RPF is produced from compacting the EPS wastes, it is that the generator has to transfer the EPS wastes to the manufacturing plant. The calorie of the burning of the EPS is higher than coal. If the waste generator can directly make the EPS fuel, recycling of the waste EPS float can be more compact. In this regard, ELCOM Co. Ltd has developed the E-PEP (Equipment to Pelletize Expanded Polystyrene) producing system which consists of a portable compressor of EPS floats, compact pelletized machine and pelletized fuel boiler (Fig. 13). If it can make fuel from the wasted EPS floats, it can reduce the fuel cost and also environmental issues. And if pelletized fuel can be used at the compact boiler and if bunker A can be used in it, the running cost of fuel can be reduced.

Figure 13. ***Compact recycling system by E-PEP consisting of portable compressor of EPS floats (left), compact pelletized machine (center), pelletized fuel boiler (Right) (ELCOM Co. Ltd.; http://elcom-jp.com/products/).***

In the light of the increase number of wasted EPS floats, it can be asserted that there is a need for the EPS float users to make use of such compact system to economically dispose them.

2) Development of the Polystyrene Buoy Thermal Volume-Reduction System

Same as EPS floats in Japan, the waste polystyrene buoys are considered as one of the most difficult types of marine litter to deal with in Korea because of their bulky volume. According to the studies, the western and southern coasts of Korea suffer from the discarded waste polystyrene buoys from the aquaculture fisheries (Jung et. al., 2010). In order to develop an environmental-friendly and sustainable polystyrene buoys treatment method, Korea has also introduced the thermal volume reduction system and in 2007, a mobile type of volume-reduction system/a truck-mounted mobile system was introduced (Fig. 14). According to the statistics conducted by government, the total number of the compressors has increased from 5 in 2003 to 35 in 2013.

Figure 14. ***Use of a mobile type of volume reduction system/ a truck mounted mobile system compressor in Korea (Korea Research Institute of Ships and Ocean Engineering).***

The compressor system consists of Polystyrene separation, cutting, crushing, cleaning, drying, storage, thermal extrusion and deodorizing, as introduced in “The report on the Technologies and Research outcomes on Prevention, Collect and Treatment of Marine Litter in the NOWPAP Region” (MERRAC, 2008).

The ingots produced by this process are 100% recycled to produce other plastic products and also to bring subsidiary incomes, partially offsetting expenses for operating the facility at the local government of the area where there is a great volume of waste buoys (Jung et. al., 2010).

3.2 Shift from the Conventional EPS Floats to High Durability Floats

In Japan, the Sustainable Aquaculture Production Assurance Act came into force in 1999. The Fisheries Cooperative Association of Tarumizu city of Kagoshima prefecture (Fig. 15) is a leading Amberjack production area of Japan. The goals of this association are sustainable development of aquaculture and provisions of safety production for the consumers based on the assumption that the fishing operations should be carried with less serious effects on the environment of the fishing grounds. The Association proposed to introduce distinctive inventions on feed, cooperation with the agricultural sector and shifting from conventional EPS floats to high durability floats.

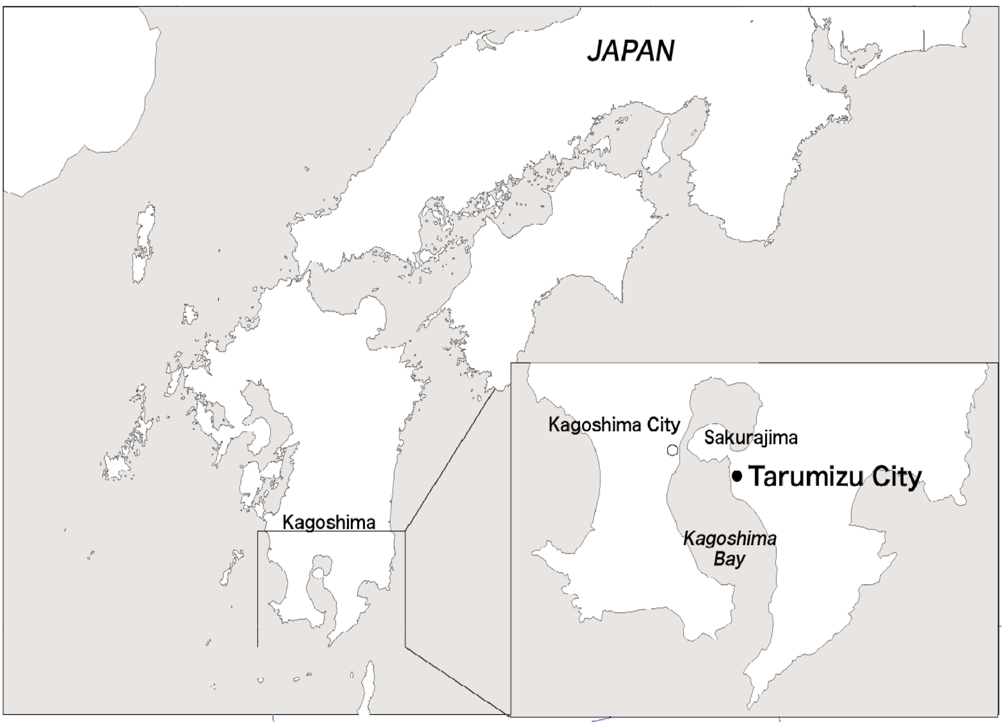


Figure 15. ***Location of Tarumizu City.***

The replacement of the conventional EPS to the new floats is necessary because of the following factors.

The conventional EPS floats have:

- Low durability: it degrades to fragments easily. The conventional EPS float's PE cover is not strong enough as it can easily be broken by bird-claws and friction with frames and boats.
- Low workability: it is impossible to scrape attached organism because the cover is less durable and weak.
- Penetration: seawater penetrates into the EPS beads by direct water contact and the weight increases hence loses its buoyant potential.
- Recycling is tedious: water and attached organisms may hinder the recycling process
- Short period of service: the expected life span of conventional EPS is 3 years. It makes huge wastes, recycling costs and needs stocking yards.

For instance, when Kagoshima Bay was hit by the Typhoon 11 in1989, all floating aquaculture rafts sunk under water. When the rafts were moved to deep waters by strong Typhoon waves, the EPS beads were crashed by the water pressure and the floats lost their buoyancy. The fishermen in the area realized the importance of changing the EPS floats in order to keep their rafts floating even in bad weather.

To solve the problem, a EPS maker (YASUI Co. Ltd.) of Kagoshima with the Fisheries Cooperative Association of Tarumizu developed and introduced high durability floats ("Power Float") which is a combination of polystyrene beads and the hard plastic (5mm thickness PE) float and easier to recycle and to handle without fragmentation.

It took 10 years for Fisheries Cooperative Association of Tarumizu to shift from conventional EPS floats to new floats because of its high cost. Now, this new float is being 100% used in Tarumizu area and it also came into wide use in other aquaculture area in Japan. The advantages of the new hard plastic are as follows:

- High durability : it can be used for over 10 years because of the hard plastic which is the main ingredient of the floats.

- Easy handling : scraping is used to remove the attached organisms on the walls of its hard surface.
- Easy recycling: water cannot penetrate and the attached organisms can easily be removed before recycling.
- No fragmentation
- Long period of service

The shift from the conventional EPS floats to the high durability floats (new PE floats) has started since 2000 and was finalized in 2009. These new floats are widely used around the area now (Fig. 16). This shift was carried out because of the intensive need of floats and the development and improvement made by the float makers.

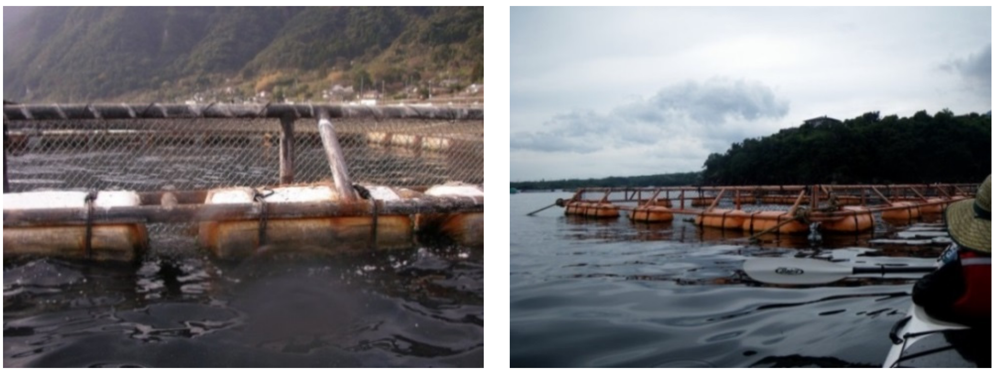


Figure 16. ***A net cage raft using Conventional EPS floats (Left) and new PE floats (Right).***

Chapter 4. Research and Development

4.1. Biodegradable Fishing Gear

The fishing gear that are used in fishing activities in the NOWPAP region are synthetic and they are resistant to degradation in the water. Those fishing gear when abandoned, lost or discarded in the marine environment continue to catch fish by what is called 'ghost fishing' which threatens wildlife and targeted fish species.

It may also cause serious economic damage to the fisheries as it results in direct costs related to time spent disentangling vessels whose gear/engine become entangled in ALDFG, which then results in less fishing time. Furthermore it may also induce indirect costs as it may lead to reduced income/value-added resulting from ghost fishing mortality, which means fish are lost from the fishery (UNEP, 2009).

The National Fisheries Research & Development Institute (NFRDI) of Korea has developed biodegradable fishing gear made of Polybutylene succinate which starts the degradation after two years of being disposed under the water and takes about 7 years for degradation (Fig. 17), while ordinary nylon fishing gear lasts for more than 500 years.

These biodegradable fishing gear have been pre-tested in gill net fisheries in Gyeongbuk Province and trap fisheries in Gyeongnam Province, Korea.

The level and duration of degradation of the biodegradable fishing gear are currently being assessed and its high price and the deficiency in the flexibility are under consideration for further improvement, under the 2nd National Basic Plan of marine litter management of the Government of Korea (MOF, 2013).

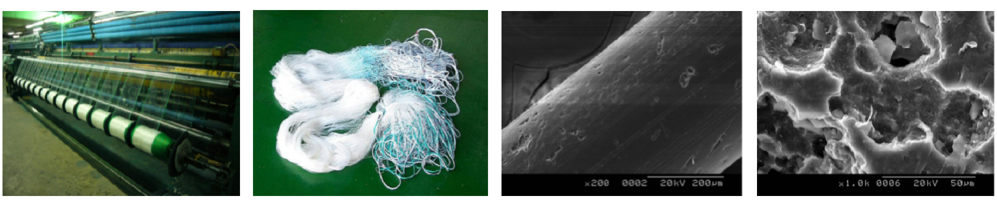


Figure 17. ***Degrading process of the biodegradable fishing gear (MOF and KOEM, 2009).***

The use of this fishing gear is envisaged for wide commercial use and the commercialization, development of new aquaculture techniques using this biodegradable fishing gear is planned to be implemented in Korea.

4.2. Fishing Gear Identification

Having a proper management system of fishing gear is the most efficient way of preventing derelict fishing gear which results in 'ghost fishing' and damages to the marine environment. In this sense, the Government of Korea introduced fishing gear identification program since 2006 through which fishermen have been asked to tag personal information on the fishing gear. The program aims at prohibiting overuse and preventing illegal dumping of fishing gear to ultimately monitor and restrict the use of the fishing nets and traps which is the main source of 'ghost fishing' (Fig. 18). The program has contributed to preventing inappropriate disposal of fishing gear.

Figure 18. ***Examples of the tags with personal information to be attached to the fishing gear.***

As part of the 2nd National Basic Plan of marine litter management (MOF, 2013), the Government of Korea has planned to expand the use of the system by 50% of the target vessels by 2018. The program will focus on implementing the system on three sectors, mainly the gill net, stow net and fish trap fishery.

Furthermore, in order to improve implementation of the program, the government is planning first, to verify the effectiveness of the program by introducing demonstration projects and second, to encourage fishermen to voluntarily participate in the program by implementing various public relations activities. Lastly, a reporting system will additionally be introduced to strengthen the effectiveness of the program in case of the loss of fishing gear during natural disasters such as typhoons and storms and also to prevent illegal dumping of fishing gear. The reporting system is planned to be implemented on a national scale after demonstration projects.

4.3. Fiber Reinforced Plastic Vessel Melting Treatment System

Fiberglass Reinforced Plastic (FRP) is synthetic materials made of a polymer matrix reinforced with fibers to mechanically enhance the strength and elasticity of plastics. They are commonly used in aerospace, automotive, marine and construction industry.

It has been used since late 1970s in Korea and the total number of FRP being used has been increasing since then. In particular, the manufacturing of the small FRP fishing vessels increased in the 1990s due to its easy and low cost manufacturing. As a result, a total of 65,000 FRP vessels were registered from 1980s (Jung et. al., 2010).

FRP, due to its high cost and complicated treatment methods when it needs to be disposed, the FRP vessels are more likely to be abandoned illegally around coasts and harbors. The abandoned FRP vessels can hamper vessel traffic and harbor safety, and inappropriate treatments of the FRP vessels may threaten the marine environment and human habitat. However, the rules of FRP disposal were vague and the proper treatment system has been absent.

In order to solve these problems, Korea Research Institute of Ships & Ocean Engineering (KRISO, former MOERI/KIOST) developed the melting treatment system of waste FRP vessels project with MOF (Fig. 19). The process is an environmental friendly treatment system which includes cutting, crushing and melting the waste FRP vessels to recycle into new energy sources.

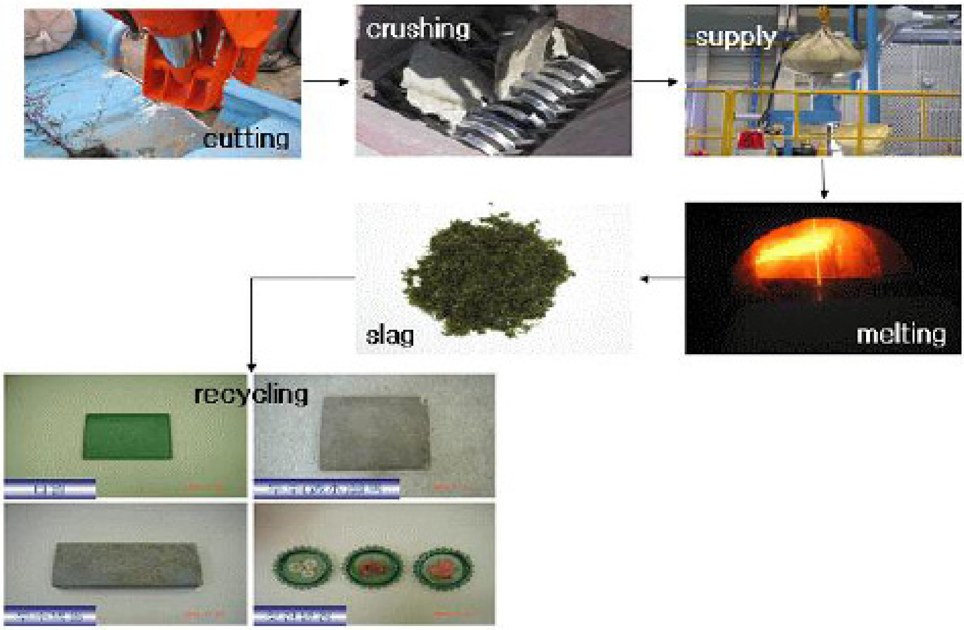


Figure 19. ***Process of waste FRP vessel melting treatment (MERRAC, 2010).***

Chapter 5. Policy-based management

5.1. Marine Litter Management in China's Coastal Cities

In view of the ever-aggregating marine litter, China's coastal provinces and municipalities have been actively carrying out the relevant work, controlling and disposing marine litter through detailed management methods based on marine litter source and process control. Currently, the marine litter management is being implemented in several cities including Dalian and Xiamen and they have shown preliminary positive results.

1) Dalian

Dalian is the Southernmost city of Northeast China which is located at the tip of the Liaodong Peninsula and it has 260 islands. To strengthen the marine litter prevention and treatment, and to preserve the seawater quality, the Dalian municipal government and private organization have taken a series of measures. The methodology contained:

- Carry out the comprehensive management of the southern coastal environment:
  Dalian has made comprehensive improvement in the severely polluted areas of Heishijiao and Lingshui due to offshore aquaculture- basically by putting an end to the buoyant raft aquaculture.

- Strengthen the port's sewage and garbage management:
  To tackle litter originated from ships, Dalian has made full use of the port's shipping service companies and other port-stationed companies. There are 7,800 ships serving the garbage discharge each year, receiving more than 6,000 tons of ship generated litter- effectively controlling the ship generated garbage at the port. Dalian Port Corporation spends considerable amounts of money to collect the floating garbage in the navigation channel and to strengthen the cleanup work, which keeps the port waters clean all year around.

- Carry out environment protection volunteer activities and combat with marine litter:
  Since 2003, Dalian's environment protection volunteers have held diving

activities to collect seabed garbage with the theme of “Blue Sea” and hosted the floating garbage cleanup activity with the theme of “creating a benign marine environment for the maritime center”. As a result, from 2006 to 2007, Dalian’s environment-protection volunteer association joined hand with both corporate and social forces to collect as much as 4,000 plus kilograms of floating garbage. Dalian citizens’ participation in the clean-up process and the investigation activities was introduced at the NOWPAP organized events. It has also gained the recognition of the Ministry of Environmental Protection of People’s Republic of China.

2) Xiamen

Xiamen is located in the Southeast of China’s Fujian Province and consists of Xiamen Island, Gulangyu, the coastal area on the North of Jiuongjiang River, and TongAn. The land area is 1,565.09 km^2 and the seawater area is 344 km^2. Xiamen is well-known for its beautiful island sceneries. Unfortunately, marine litter problem in the city has been worsened in recent years. Although Xiamen is not actually located within the geographical boundary of the defined NOWPAP region but the method introduced by the city can illustrate a good example on how a tourist city deals with the marine litter issues.

In Jinmen beach alone, for example, a total of 800 tons of garbage was collected in 2007. The garbage was mainly comprised of land-sourced household garbage, offshore aquaculture and ship generated garbage, aquatic plants and agricultural production wastes etc.

Fujian government held the Xia-Jin Seawater floating garbage rectification work meeting in Xiamen in June 2007 where they proposed the relevant methods for tackling with the floating garbage in this area and passed the special plan of marine environmental sanitation in Xiamen.

The methodology of the proposed plan contains of several aspects including:

- Establish Xiamen Offshore Environment Sanitation Management Center and implement the divisional management of marine sanitation. In order to coordinate the whole municipality’s marine environment sanitation management, it adopted the method of keeping the program by charging fees, and implements the enterprise-style management

- Set up marine environmental sanitation base, equipped with the relevant facilities and personnel. The city planned to set up five environmental sanitation bases in its four administrative districts outside the island.

- Set up offshore ship garbage collection systems which include three collection and transfer modes to uniformly dispose ship garbage (The No.1 Wharf and Dashihu can be constructed as pilot projects):
  - Set up stations at the seashore, enabling ship garbage to be delivered to onshore. Establish a ship garbage collection site respectively at the No. 1 Wharf and nearby Dashihu, in a bid to facilitate ships' delivering garbage.
  - Go to ships which cannot tie up at the shore and collect garbage from them regularly, employ specialized boats and go into big ships to collect the garbage regularly according to their normal garbage volume.
  - Make use of the merits of small wooden boats to collect garbage by request at key scenery spots such as Gulangyu, Baicheng and Yanwuqiao etc. Anyone can wave their hands to request the small boat to collect their garbage at any time.

In 2009, Xiamen, Zhangzhou and Longyan of Fujian province, jointly stipulated the water pollution prevention and treatment plan and the water environment protection plan for Jiulongjiang River area. At the same time, Xiamen arranged USD 1.6 million (CNY 10 million) each year to coordinate the treatment of garbage pollution problem of Zhangzhou and Longyan. Statistics showed that Xiamen's marine litter volume has been decreasing year by year though the sanitation-keeping area has doubled. It seems a preliminary positive result has been achieved.

5.2. Ship Generated Waste Management in Russia

1) Organizational Aspects of Marine Litter Management

Marine litter tends to accumulate on coastlines. Waterborne plastic poses a serious threat to fish, seabirds, marine mammals and other animals and its habitat. Ocean dumping, accidental container spillages, litter washed into storm drains, and wind-blown landfill waste are all contributing to the marine pollution.

A certain concern is peculiar for the search of best practices in marine litter management, collection and disposal. The study demonstrated that the remote coasts and water areas are less littered than those near inhabited localities, and the pollution comes from long distance. Long-term monitoring of Russian coastal and marine areas shows that the most littered are the harbors. There are basic and necessary policy methods implemented in Russia, aiming at marine litter management in basic maritime economic branches such as fishing, aquaculture and shipping.

According to the acting standard guidelines, the constant operating control over the conduction of the cleanup of the polluted port water areas is carried out by port supervision inspectors irrespective of the type of port activity. Each port should be equipped with special facilities providing waste reception, including litter and oil-containing waste.

Each port develops the optimum schedule of port service, reflected in the plan of ship waste management which is approved by the captain of the port. The plan on ship waste management represents the document defining the port policy in waste management, its purpose, payment system which is created for successful work of system on collection and recycling of ship waste, and defining organizational structure, duties and responsibilities of the parties.

The plan is developed with account of the international and national regulatory and legal framework for the purpose of providing efficiency of ship waste management in ports.
Besides administration of seaport, functions aimed at liquidation of consequences of pollution of water areas and territories of seaports, collection of ship waste and its further recycling are to be performed by branches of Rosmorport Federal state

unitary enterprise. Within the NOWPAP region, Vladivostok, Dalnevostochny, Vostochny, Vanino and Sakhalin branches of Rosmorport are located.

As a rule, management of ship waste and litter collected from the water surface is carried out by specialized organizations which carry out waste reception, partial sorting and transportation to the recycling place. Waste of 4^{th} and 5^{th} classes of hazard is transferred to municipal landfills for the burial. Waste of higher classes of hazard according to contracts is transferred to specialized organizations for further neutralization and recycling. The environmental fleet used for cleaning of water areas consists of specialized litter collecting vessels.

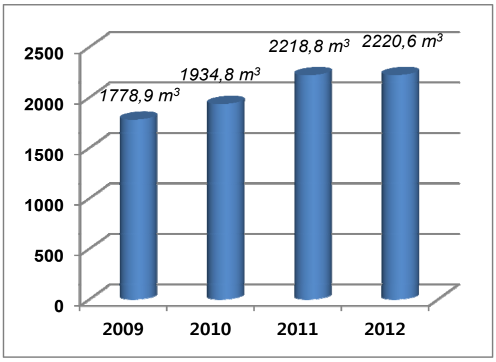
Vladivostok branch has 2 garbage collection vessels and Vostochny and Vaninsky branches have 7 and 2 vessels, respectively. To deliver the waste to port facilities, the ship-owner makes an application 24 hours prior to the operation. Specialized vehicle arrives to the specified place near vessel to receive and transport the waste (Fig. 20). Upon acceptance of waste from the vessel, a related document in triplicate is signed by the captain of vessel and assured by stamp. The document specifies types and quantity of the collected waste. To pay the rendered services the environmental toll is excised which depends on port, type of vessel and navigation.

Regarding litter collection and other pollution from water surface the customer (port administration) according to the concluded contracts makes an application which is considered within 24 hours. In the absence of technical restrictions the corresponding services are rendered. The operational costs for oil collection vessel are estimated on the average at USD 84 (RUB 3000/hour).

In connection with the increasing turnover of goods in ports of the Russian sector of NOWPAP, an increase of the volumes of the waste collected from ships and quantity of litter collected from water surface have been registered. For example, the left diagrams of Fig. 21, 22 and 23 show dynamics of the registered ship's waste in Vladivostok, Vostochny and Nakhodka seaports; and the right diagrams of the same figures show data on the litter collected from water surface in the considered ports.

The litter collected from the surface is transported to the place for treatment where the licensed organizations have corresponding agreements with port administrations and Rosmorport Federal state unitary enterprise.

Figure 20. ***Collecting waste from vessels in Vladivostok port.***



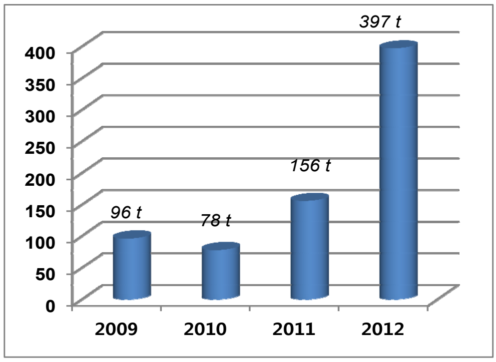
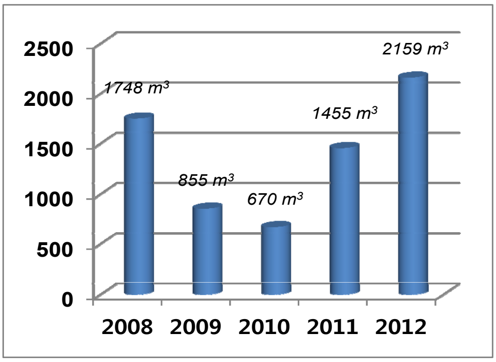


Figure 21. ***Volume of the total collected waste (Left) and quantity of the waste collected on the water surface (Right) in Vladivostok port.***



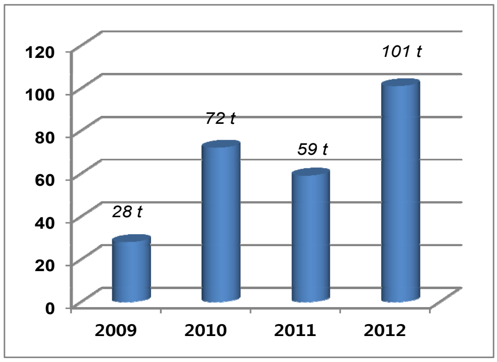
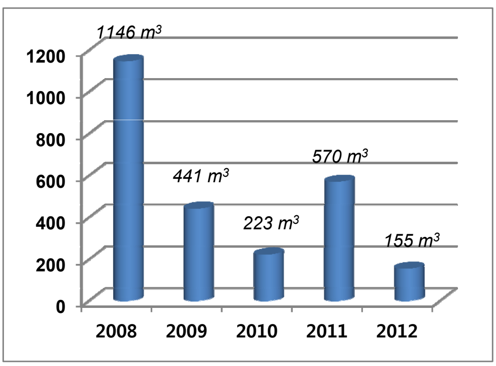


Figure 22. ***Volume of the total collected waste (Left) and quantity of the waste collected on the water surface (Right) in Vostochny port.***



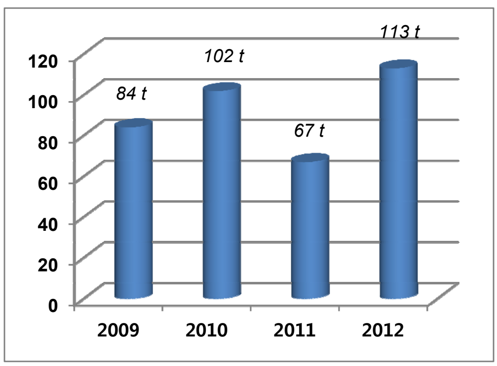


Figure 23. ***Volume of the total collected waste (Left) and quantity of the waste collected on the water surface (Right) in Nakhodka port.***

2) Techniques of Collection and Disposal of Waste on Ships

Technologies of waste recycling mainly depend on the type of the waste. All waste generated from ships and those that are able to potentially contaminate water areas can be divided into the following groups:

- operational waste, including plastics;
- household waste (food waste, paper, glass);
- rags.

Most of wastes that need to be treated are presented as oiled paper, rugged ropes, fishing nets, remains of cargo, and metal fragments. In addition, while recycling (incineration) the waste, ashes and sludge are formed, which in turn, make another form of waste.

According to the studies, household wastes such as food waste, paper and glass do not present any danger to the environment as far as it undergoes quick decay. Paper waste also does not represent any special danger, but is capable of giving negative impacts on the aesthetic value of the place. The places of ships generating household waste are generally from galley, dining room, wardrooms, sanitary and hygienic premises, inhabited cabins, corridors and industrial and power premises. The litter from these premises is collected to the garbage tanks which can be represented by any storage reservoirs marked according to standard requirements.

In order to reduce the amounts of wastes, the ships are provided with specialized installations for litter destruction to transfer the waste to floating and coastal reception facilities.

Collection and sorting of litter is carried out directly in places of its generation (Fig. 24), such as dining rooms, wardrooms, sanitary-and-hygienic premises, inhabited cabins etc. The litter from these premises is collected in the garbage tanks which can be represented by any storage reservoirs.

Three types of garbage tanks are applied on vessels in general:

- bins for inhabited and office rooms;
- enameled buckets with lids for litter collection on galley and in public catering places;
- boxes for collection of litter in cargo and industrial premises.

Waste sorting requires that such components of litter as glass, metal, ware splinters and so forth could not get to the combustion chamber of incinerator. All these nonflammable components of litter are left in separate storages and kept on a vessel before arrival to port and transfer to the waste collectors.

Figure 24*. The example of marked trash reservoirs on vessel.*

Most of vessels have waste incinerators which allow to considerably reduce volume of remaining wastes. Grinders are applied to process food waste and plastic litter press devices are applied for plastic debris.

3) Techniques for Collection of Floating Wastes on Water Area

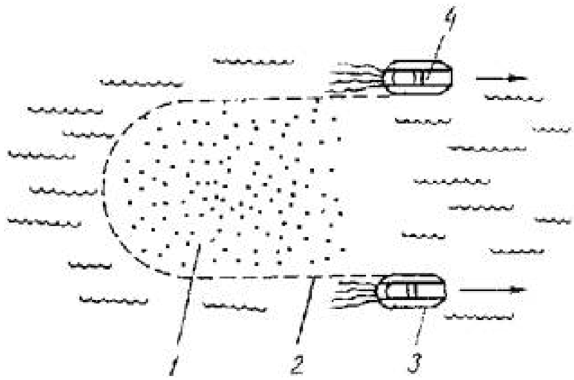
- In cleaning the water areas, following factors should be considered:
  - the characteristic of pollution in port area;
  - the characteristic of polluting substances floating in port area;
  - hydrometeorological conditions in port;
  - the characteristic of tools and methods for localization of oil spills;
  - the characteristic of tools for oil and litter collection, methods of cleaning of port water areas;
  - security measures at cleaning of port water areas.

- Regular cleaning of water area can be conducted in the following areas:
  - from open water area;
  - from closed sites of water area (between vessel and mooring and between two vessels);
  - sites of water area along moorings and piers,
  - water area sites in the corners of moorings;
  - water area sites under hinged and piled moorings and piers.

The intervals between regular cleaning processes are established by port administration depending on the degree of water pollution. Cleaning of open port water area should be conducted differently from oil and waste collection vessels.

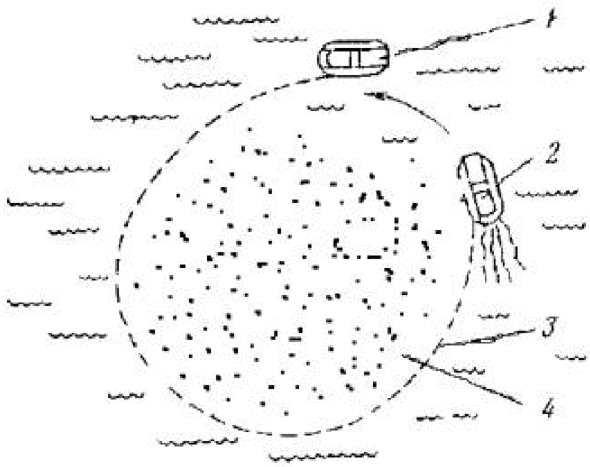
At still weather, floating litter is distributed along the water areas in regular intervals; therefore the open part of water area can easily be cleaned by surrounding of the polluted site with booms.

- The cleaning activities in open water areas by surrounding the polluted sites with booms can follow the following activities:
  - The ends of boom containment (the length is chosen depending on the size of the polluted site) are fastened to bows of two waste collection vessels;
  - Cleaning of open water area is initiated at the most polluted site;
  - Waste and oil collectors move at low speed forward at parallel course (Fig. 25);
  - The distance between waste and oil collectors is chosen depending on maximum capture of polluting substances;
  - After waste and oil collectors leave out of pollution range, one of the vessels stops, and the other approaches to the first vessel in circle, finally mooring its bow to the stern (Fig. 26);
  - Waste and oil collector starts to suck in litter from the surface of surrounded area, gradually reducing the area through constant towing of boom containment line along board to stern (Fig. 27);
  - Cleaning of the contained site is stopped after removal of all floating litter, and then operation is repeated for the next site of water area.



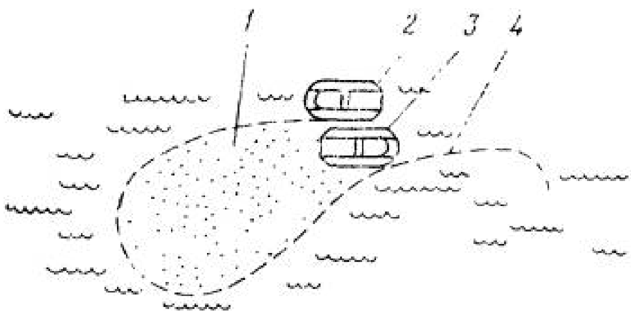
(1) marine litter; (2) booms; (3) specialized vessel for water area cleaning;
(4) auxiliary specialized vessel for water area cleaning

Figure 25. ***Course of a specialized vessel for water area cleaning when cleaning the open water area.***



(1) auxiliary specialized vessel for water area cleaning;
(2) specialized vessel for water area cleaning; (3) booms; (4) marine litter

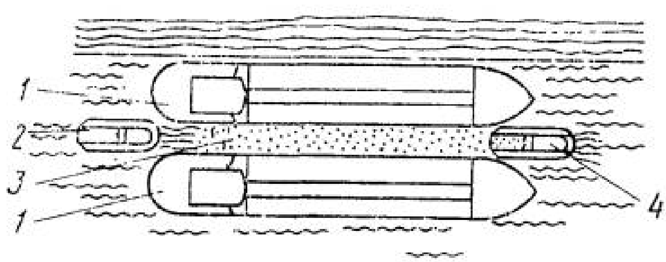
Figure 26. ***Protection of the polluted site by booms.***



(1) marine litter; (2) auxiliary specialized vessel for water area cleaning;
(3) specialized vessel for water area cleaning; (4) booms

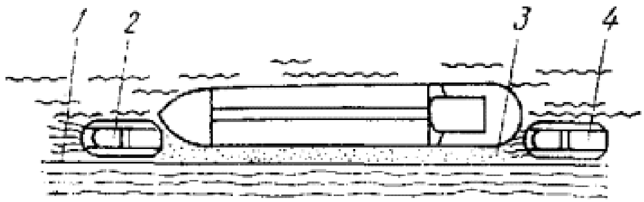
Figure 27. ***Marine litter collecting from protected site of the open water area.***

- For closed sites, when floating litter is accumulated between vessels and moorings, the cleaning activities are carried out as follows by two waste collectors:
  - Waste and oil collector approaches upon the leeward to the vessel bow at slow speed until stop at close range;
  - The second collector approaches backwards from the stern of the vessel at minimal range and after fastening mooring lines uses its propellers to move superficial water layer to the first collector (Fig. 28 & 29);
  - Moving of superficial water to reception mechanism of the cleaning vessel can also be provided by a jet of water from fire nozzle;
  - Large sized litter is collected with dip net or boat-hook.



(1) vessel; (2) auxiliary specialized vessel for water area cleaning;
(3) marine litter; (4) specialized vessel for water area cleaning

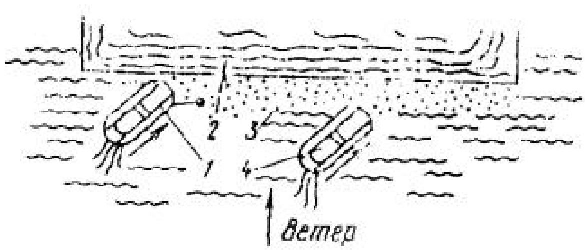
Figure 28. ***Marine litter collecting between two vessels.***



(1) pier; (2) specialized vessel for water area cleaning; (3) marine litter;
(4) auxiliary specialized vessel for water area cleaning

Figure 29. ***Marine litter collecting between vessel and pier.***

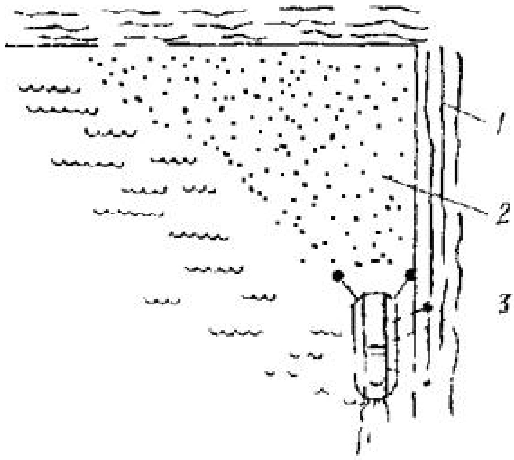
- Cleaning activities to remove litter at moorings, piers and seawalls:
  - The cleaning is carried out at slow speed, while collector ship hull positions at an angle of 15-30^{o} to the construction (Fig. 30):



(1), (4) – specialized vessel for water area cleaning; (2) pier;(3) marine litter

Figure 30. ***Marine litter collection at piers and moorings.***

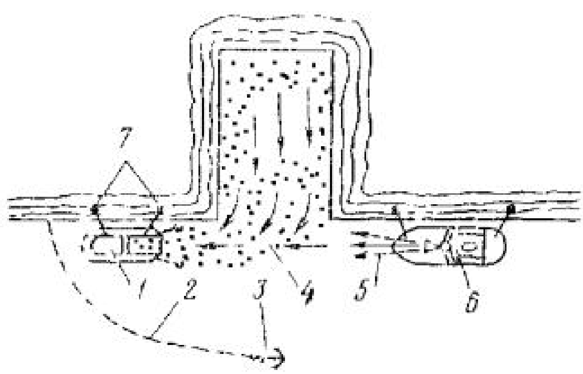
- Cleaning in corners of piers:
  - The cleaning is carried out when waste collector is moored and moves slowly by the pier (Fig. 31). Preliminary boom installation is provided.



(1) piers;(2) marine litter; (3) specialized vessel for water area cleaning

Figure 31. ***Marine litter collection in corners of piers.***

- To clean dead zones under piers and moorings:
  - The air under pressure is applied. Boom containment is set behind the stern of waste collector to prevent litter going into the open water area (Fig. 32).



(1) specialized vessel for water area cleaning; (2) booms;
(3) anchor; (4) deaf pocket; (5) water stream; (6) fire boat; (7) mooring rope

Figure 32. ***Marine litter collection in deaf pockets with water stream.***

There are measures taken by local government to prevent and collect marine litter and companies are also performing activities on the water area.

The requirements of the Compulsory Regulations on the Sea Port are binding for all vessels staying within the port waters and miniports of registry waters, regardless of their departmental affiliation and form of ownership, as well as for legal entities and physical bodies conducting their activities within the water areas and territory of the port and the miniports of registry.

According to the sub-clause 4.9.8 of clause 1.3 of the Compulsory Regulation on the Sea Port which states on responsibility for the state control of the natural environment pollution prevention with the Harbor Master, wharfingers or berth operators are responsible for the cleanliness of berths and the adjacent territory and water area. According to these rules, the techniques for cleaning the territory, berths and piers from snow, ice, production waste etc., are to be agreed upon with the Administration of the Sea Port and approved by the state agencies of the environmental and sanitary surveillance. Persons found guilty of the environment pollution are held liable to penalties and damages recovery as stipulated in the Russian Federation legislation which is currently in force. Furthermore, pollution cleanup operation costs are to be covered by the guilty party, regardless of any penal action taking place and Federal Service of nature management inspectorate (of the local representatives) controls the infringements.

Chapter 6. Conclusion and Recommendations

Marine litter is causing negative impacts on aquaculture, marine ecosystems, habitats and biodiversity, navigational safety and tourism in the NOWPAP region. The sectors most affected by marine litter were found to be fishing and aquaculture, followed by tourism and recreational activities (MERRAC, 2013).

In the view of ever-aggregating problem of marine litter, the NOWPAP members have actively been making efforts in reducing the amount of marine litter and addressing marine litter issue at national level. For instance, in some of the NOWPAP members domestic laws and regulations related to the marine litter management have been amended and enacted and, policies and strategies have been adopted by the central and local governments to fight against marine litter issues. In line with these national efforts, the region has also tried to seek ways to cooperatively solve the marine litter problems at the regional level through implementation of different public awareness activities and campaigns such as International Coastal Cleanup (ICC) campaigns.

Furthermore, different marine litter management measures have been introduced and implemented in the NOWPAP region and among the various ways of dealing with marine litter, efficient collection system, environmental-friendly disposal techniques and policy-based management as well as the R&D have been selected and presented in this report, in order to tackle with the negative impacts of marine litter in fisheries, aquaculture and shipping sectors in the NOWPAP region.

The various approaches to marine litter management have been taken by the NOWPAP members respectively according to local situations:

1) An efficient collection system introduced by the Government of Korea has been successful in dealing with abandoned, lost or otherwise discarded fishing gear (ALDFG). The three programs (Buy Back program, floating receptacles and clean fishery communities program) have successfully drawn fishermen's attention and volunteerism by introducing economic incentives. It can be a good practice of a win-win strategy for both the government and the fishery communities. Through such programs, the government will be able to clean and prevent marine litter

generated from fishing activities and at the same time promote public awareness and the fishery communities will benefit from improved and clean fishing environment and also economic incentives.

2) Exercising a proper disposal technique is as important as collecting marine litter. Especially when the volume of the collected marine litter is big, like the EPS floats, commanding good disposal techniques can be critical. Both Japan and Korea where the aquaculture takes a significant part of the fishing industry have been developing compressors and eco-friendly recycling techniques and systems to treat the used EPS floats. Such techniques might be useful for other countries as well.

3) Research and development (R&D) is another important factor that contributes to reducing and preventing marine litter. For example, one of the troublesome aspects of marine litter is the post treatment such as recycling after the collection of the litter. R&D techniques can help to efficiently recycle collected marine litter or even to eradicate the root cause of marine litter through e.g. development of biodegradable fishing gear. The sharing of R&D results will enhance and stimulate regional capacity and cooperation.

4) Lastly, successful management starts from good policies. The policy-based management measures which were introduced by the Government of China and Russia set a good example of how both public and private sector can work cooperatively to solve the marine litter problems.
   Promotion of private-public partnerships can be one of the most effective ways to tackle the marine litter problems. The collective marine litter strategies between government and private sector can also promote fair and systematic burden sharing.

The following recommendations can be drawn after sharing information on best practices introduced by each NOWPAP member:

1) Promotion of exchange of information and continuous support for prevention of marine litter:
   The effect of the proper marine litter management increases when it is voluntarily introduced but the effects become bigger when public and private sector are teamed up to face the issue together. The effects will multiply when the individual

member states share their best practices. Each party or entity may have different position but having close relationship between different entities which can be the public and private sector, fishermen and nations will gradually reduce marine litter in the region.

2) Implementation of the shared best practices and consistent monitoring on the results:
   Sharing such knowledge and technologies among the NOWPAP members can be one way to be constantly updated on new technologies and improve the existing management. The NOWPAP members may benefit from sharing best practices as these good practices can be applied to the cases where the environmental circumstances are found to be similar, eventually shortening the implementation process. It is also important that the implementation of best practices is followed up by monitoring which in turn, can lead to improvement of the existing strategies.

3) Promotion of public awareness and participation:
   Public awareness can be the key element in reducing sea-based marine litter given the fact that the most of the litter originates from fishing activities which in other word means that changing the fishermen’s or users’ attitude may make a huge difference. In this sense, it is important that the government works collectively with various stakeholders especially the interested parties such as the fishery communities, to first strengthen public awareness and also to give practical proposals for the prevention of marine litter problems.

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