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Environmental policies and practices in Cruise Ports: Waste reception facilities in the Med

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Abstract

With cruise activities continuing to grow, the cruise world and related decision makers take initiatives aiming to handle the produced externalities. Among the key environmental issues is the handling of the various wastes produced on cruise ships. In recent times, cruise lines and ports have put efforts into reducing, selecting and managing generated wastes implementing the requirements of the international regulatory framework (MARPOL 73/78), as well as those imposed by the European legislation. This study focuses on the state port reception facilities (PRF) in the case of the second biggest cruise region of the world, the Mediterranean and its adjoining seas. In particular, it sheds light on the extent that the current practices of cruise ports have achieved a satisfactory level of compliance to the emerging environmental related international regulatory framework. The paper does so via a survey that maps the existing conditions and port based practices followed by 40 port entities that manage 52 cruise ports in the region. The findings record the available facilities, technologies and services suggesting a widespread effective correspondence to required adjustment. It also details a variation as regards the charging practices, that might affect the level playing field. The analysis generates knowledge on the emphasis given by cruise ports in addressing environment challenges. Given that the European Directive governing PRF is currently (2016) under review, the study provides practical recommendations to decision makers and practitioners on what can be done so as to further secure a sustainable cruise future.

Keywords: cruise ports, waste reception facilities, Mediterranean, ports, MARPOL, sustainable cruise.

JEL Classification: F64, L91, Q53

1. Introduction

With shipping accounting for approximately 20% of global discharges of wastes and residues at sea, reducing discharges of all kind of ship-generated waste and cargo residues into the sea is closely linked with the protection of the marine environment. Ports have a key role to play in order to achieve this goal. The development of adequate port reception facilities (PRF),

together with the establishment of systems that provide incentives for ships to use these facilities, are major elements aiming in a process to reduce ships' discharges into the sea.

The International Maritime Organisation (IMO) has moved to address the delivery of ship-generated waste and cargo residues via initiatives aiming at enhancing the availability and suitability of PRF. In particular, regulations and requirements defining which wastes can be discharged into the marine environment have been adopted as part (Annex) of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78).

The European Union (EU) has followed within the same vein. Targeting to further enhance the presence of effective PRF in the region, European institutions adopted in 2000 the relevant Directive 2000/59 (CEU, 2001). Today, fifteen years later, the provisions of this directive are under review. The requirements of this framework, and the consequent applications, differ depending on the port market. There are different requests in the case of cargo and oil markets, from those in the case of cruise ports. This is not least because different wastes are produced in the case of each shipping market.

In this study we focus on the state of waste reception facilities in the case of cruise ports. With the growth of cruise activities continuing, the cruise world takes initiatives aiming to handle the produced externalities. Among the key environmental issues to be addressed is the handling of the various wastes produced on cruise ships. In recent times, cruise lines and ports have put a lot of efforts into reducing, selecting and managing generated wastes implementing the requirements of MARPOL 73/78 as well as those imposed by the European legislation.

The paper analyses the state of PRF in the second biggest cruise region of the world, the Mediterranean and its adjoining seas. It examines the extent that the current practices have achieved a satisfactory level of compliance to the emerging regulatory framework. The paper does so via a survey of the existing conditions and practices followed by 40 port entities that manage 52 cruise ports in the region. The findings record the available facilities, technologies, and services suggesting widespread effective correspondence to required adjustments.

The theme of the paper corresponds to calls for broadening the scope of port studies to integrate in port governance research environmental issues. As the review of studies in port management, economics and policy by Pallis et al (2011) revealed, scholars have only occasionally paid attention on how environmental issues are governed, and this is mostly due to the examination of developments in the Californian ports of Los Angeles and Long Beach (see also: Notteboom et al, 2013). Yet, the EU environmental policies targeting the sustainable development of ports, and the broader transportation sector are inextricably linked with a number of governance issues (Platias, 2016), thus these port governance issues deserve attention.

The surveyed ports standing as the hosts of a significant part of global cruise activities. In 2015, when cruise ports in the region hosted in total approximately 14,000 cruise vessels and a total of over 34 million passengers movements, the ports that participated in the survey hosted 14.8 million passenger movements, representing approximately 44% of the total (MedCruise, 2016). Thus, the paper generates more than just knowledge on the emphasis that cruise ports give in order to address environment challenges. It also provides practical

recommendations on what can be done so as to further secure a sustainable cruise future, when the European regulatory framework governing PRF is under review.

2. Regulatory Requirements in Europe

Cruise shipping causes diverse impacts on the environment. One of them is due to garbage generation that might be harmful when it is not properly managed. The amount and types of waste may vary from one ship category to another, but cruise ships are at the highest amount of garbage producers.

Responding to this challenge, the Annex V of the international Convention for the prevention of pollution from ships (MARPOL 73/78) sets restrictions on the handling of garbage, including all food, domestic, and operational waste. Garbage might be dumped overboard when a vessel reaches a certain distance from shore as long as the ship follows waste discharge guidelines. Annex V prohibits dumping garbage from 3 to 25 miles from shore, unless it is ground into small pieces. Disposing of plastics is also prohibited in territorial waters of all countries that have signed Annex V. In addition, MARPOL imposes an obligation on certain parties to provide facilities for the reception of ship-generated residues and garbage that cannot be discharged into the sea. These reception facilities should meet the needs of ships using the port, without causing any undue delay for ships.

The EU followed in 2000, adopting Directive 2000/59 on port reception facilities (CEU, 2000), the so-called PRF Directive. The Directive supports the objectives of the EU environmental policy and aims to substantially reduction of illegal discharges of ship-generated waste and cargo residues into the sea by improving the availability and use of port reception facilities.

The key requirements of the PRF Directive include an obligation of member states to ensure the availability of PRF adequate to meet the needs of ships normally visiting the port, without causing undue delay. Ports have to develop and implement a waste reception and handling plan, following consultation with relevant parties (in particular port users) and subject to evaluation and approval by the competent authority in the respective member state. The master of a ship completes a notification form and forwards it at least 24 hours prior to arrival, in order to inform the port of call about the ship's intentions regarding the delivery of ship-generated waste and cargo residues. There is a mandatory delivery for all ship-generated waste, taking into account a possibility for the vessel not to deliver waste if it has sufficient dedicated waste storage capacity until the next port of delivery. As regards the covering of the associated costs, the implementation of a cost recovery system (e.g. a waste fee) is foreseen, providing an incentive to ships not to discharge ship-generated waste at sea. Finally, there is a provision for an enforcement scheme, by which member states ensure that any ship may be subject to inspection.

The European PRF Directive pursues the same aim with MARPOL, which has been signed by all EU member states. However, in contrast to the Convention, which regulates discharges by ships at sea, the Directive applies only on ship operations in EU ports. It addresses in detail the legal, financial and practical responsibilities of the different operators involved in delivery of ship-generated waste and cargo residues.
The total of the EU waste management legislation might be divided into five thematic categories containing individual legislative instruments:

1. Framework legislation on waste
2. Legislation on waste management operations
3. Legislation on specific waste streams
4. Reporting legislation
5. Links to other in/directly related legislation

In mid-2010s the European Commission agenda includes the revision of the PRF Directive, with earlier amending acts including Directive 2002/84 and Regulation 1137/2008. This follows a standard EU practice as regards environmental related initiatives (see: Tsaltas and Platias, 2010). The scope of the current exercise is a 'refit' that will address the realised difficulties in the implementation of the initial Directive, so as to avoid the presence of inadequate reception and handling by PRF and/or inadequate delivery by ships of their waste cargo residues. Securing the presence of a level playing field between ports and between port users and minimising any unnecessary administrative burdens on port users are two additional issues that are part of the agenda (CEU, 2015).

The on-going discussion within the EU institutions, and between these institutions and stakeholders– i.e. in the context of the special sub-groups established within the European Sustainable Shipping Forum (ESSF) – concentrates on the reinforcement of the waste hierarchy. Issues under discussion include the separate collection in view of reuse and recycling of ship-generated waste, the systematic consultation of stakeholders in the development and updating of waste reception and handling (WRH) plans, the transparency on the various elements of costs charged to port users for the use of PRFs realignments, including the introduction of a 100% indirect fee for garbage, and the most accurate definitions for 'cargo residues' and 'ship-generated waste'.

In this context, empirical research on the state of PRF in cruise ports, and conclusions on whether inconsistencies exist, is wanted. Mandatory compliance is not enough to secure uniformity of port level practices. Given the differences in size and traditions of European (cruise) ports, the variation of infrastructure, or the dissimilarities between WRH plans developed by port authorities, and approved by relevant competent authorities, might be significant. The same might apply as regards the on-shore selection of the wastes that are segregated on board. Thus, empirical evidence will provide evidence on whether authorities operating cruise ports have acted as smart ones (Chlomoudis and Pallis, 2004) developing an integrated approach of waste management or not.

2.1 Towards an Integrated Approach of Waste Management

Since the adoption of MARPOL, cruise lines and port authorities implement environmental management systems in order ensure that their operations are conducted in an environmentally friendly way. Cruise lines put efforts into reducing, selecting and managing the garbage generated on board in line with the provisions of the MARPOL Annex V requirements. An environmental policy goal of "zero discharge" for solid waste at sea has been endorsed by several of them. To reach this goal, during the last years cruise lines target to reduce waste generation almost in half.

Similarly, cruise ports seek to implement solid waste management and develop facilities, technologies or services aiming to allow continuity to a cruise ship's garbage life cycle in a more efficient way. The implementation of MARPOL involves separate perceptions between

the way waste management from vessels is carried out and the systems and controls implemented in land-generated solid waste management. As there are differences between land-based and maritime waste management, the MARPOL Annex V garbage classification varies from the segregated types of garbage put in practice onboard and ashore with destination for recycling.

Yet, in order to avoid a ship-shore interface break, an on-board and ashore integrated solid waste management system is essential. Developing and implementing comprehensive programs where all types of waste and all parts of the waste management process are considered together might best address the adverse impacts of waste management. This is due to the fact that the implementation of the appropriate waste management schemes that would enable to avoid abrupt breaks in the life cycle of waste streams sorted and collected on-board and their transfer ashore.

Depending on the ship size, the number of persons on board, the ship-operating route, the duration of voyage, and also the time spent in the respective areas, discharge into the sea should be prohibited or restricted to time spent in port. The quantity and types of garbage to deliver by cruises into a port reception facility may vary a lot and that makes the ports waste services planning and provisions more difficult to manage in terms of demand, capacity and adequacy under Annex V of MARPOL.

A holistic approach would take into account five over-arching principles for waste management:

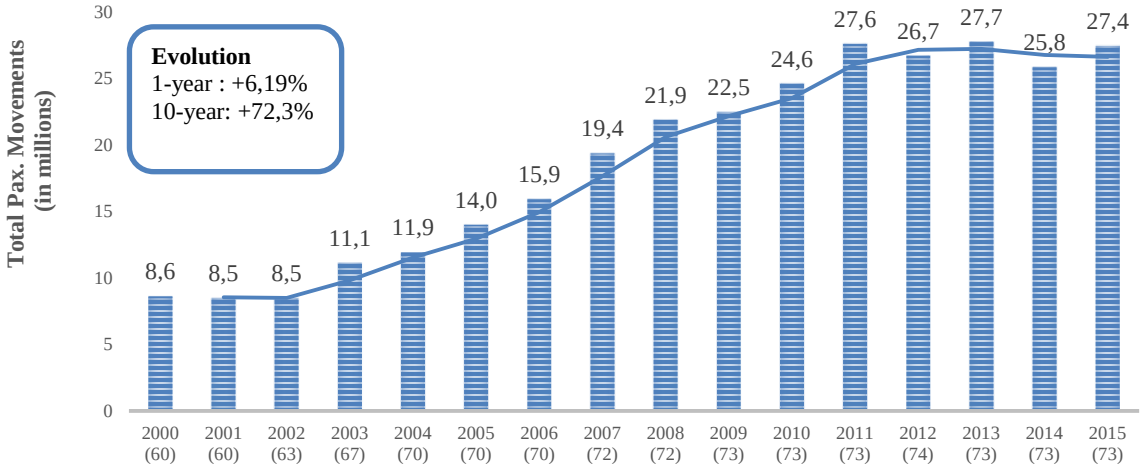
- *Waste management hierarchy*, aiming primarily to prevent the generation of waste and to reduce its harmfulness - were this is not possible, waste materials should be reused, recycled or recovered, or used as a source of energy. As a final resort, waste should be disposed of safely.
- *Self-Sufficiency at community* - along with the establishment of an integrated and adequate network of waste disposal facilities.
- *Implementation of best available techniques not entailing excessive cost* – so that environmental costs are reduced as much as possible and in the most economically efficient way.
- *Proximity* – as wastes should be disposed of as close to the source as possible
- *Producer Responsibility* – where economic operators and particularly manufacturers of products, have to be involved in the objective to close the life cycle of substances, components and products from their production throughout their useful life until they become a waste.

3. The Port Market Under Examination

Given the strong consumer interest in cruising, the expansion of destinations and itineraries, and the further modernisation of the cruise fleet and cruise product, stakeholders look forward to further growth. As Cruise Lines International Association, has projected, 24,2 million people cruised within 2016, comparing with 23,4 million in 2013, and with the number of cruisers worldwide expected to be more than 25,3 million in 2017 (CLIA, 2016). The resumption of the American market, the continuation of growth in Europe and Australia, the rapid growth in the China and the rest of the Asian market, are the factors for a longer-term projection of 30 million single persons to cruise in 2024 (Peisley, 2014).

Among the regions that benefited from this long-term growing trend of cruise shipping is the Mediterranean and the adjoining seas. Despite the financial downturn, the political unrest, and the negative publicity that followed the Costa Concordia incident in 2004, cruise activities demonstrated a growth each year of the 21st century. This is illustrated in the data collected by MedCruise (2016), the Association representing cruise ports in the Med and its adjoining seas (Figure 1**)**. The decade 2006-2015 cruising around the Med experienced growth by 72,3%. Since 2011 more that 25 million passenger movements where recorded per annum in the more than 100 ports that are managed by the 73 port members of MedCruise. At the three first years of the century this number was standing at less than 10 million passenger movements. Today the Med stands as the second biggest cruise region in the world, hosting approximately 18% of the global cruise activities.

Figure 1: Cruise Passenger Movements in MedCruise port members (2000-2015)



Source: MedCruise, 2016.

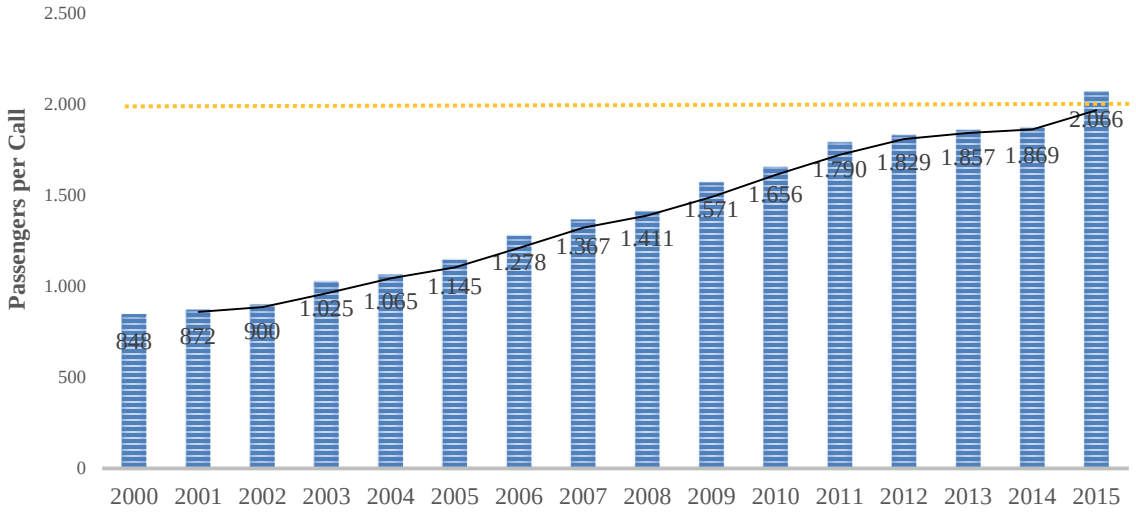
The rising capacity scale of cruise vessels stands as a major trend in the industry, along with the renewals of cruise vessels, the improvements in shipbuilding, ports, the growing interest of destinations that allow for planning of more complex itineraries, and the sophistication and specialisation of the product offered (Pallis, 2015). Cruise lines jockey to reach growth with bigger vessels, and the economies of scale that this increase of vessels size produce (Merk, et al, 2015).

Since the turn of the century the average size of cruise vessels increased to 200 metres long, 26 meters beam, and a passenger capacity of 3,220 passengers. Two vessels hosting more than 6,000 passengers, eight vessels of capacity more than 4,000 passengers and 19 of the 37 cruise ships having a capacity of more than 3,000 passengers have been delivered since 2009 (Pallis, 2015). In absolute numbers the global fleet of cruise vessels remains rather stable over time. The deliveries in 2017 will bring this total to 318 vessels, while the order book suggests that in 2019, 321 cruise vessels will be deployed around the globe. Overall, the total of berths deployed increased by 26.5% within the last seven years, from 373,400 in 2009 to 498,700 in 2016 (Cruise Industry News, 2016).

The way that the growth of cruising in the Med was achieved is indicative. Cruise movements in the region almost tripled within the most recent decade, without however a parallel

increase in the number of calls. The total of cruise ship calls in the same sample of cruise ports (MedCruise members) reached in 2015 a total of 13.194. This was lower by 4,4% of the cruise calls recorded in 2014, more than a thousand less than the 14.852 calls of 2010, and less than a thousand more (growth 5,6%) than the 12.223 calls that had been recorded then years earlier (MedCruise, 2016). The hosting of more passengers per each cruise call has taken place every single year (Figure 2). Within the year 2015 alone, this growth reached 10,5% more passengers per call comparing to the year before, while the respective growth over the last decade equals to the remarkable 61,7%. Although this average needs to be treated with some statistical caution (i.e. the analysis of the standard deviation, and the kurtosis of the distribution might indicate that this growth is not even in all ports of the sample), the structural change is undisputed. In absolute numbers, 2.066 passenger movements per cruise call were recorded in Mediterranean cruise ports within 2015, comparing to 1.278 passengers per call in 2006. At the beginning of the 21st century, a cruise port was hosting on average 848 cruisers, whereas 2003 is the first year ever that this average exceeded the 1.000 passengers milestone.

Figure 2: Average Pax/Call in MedCruise port members (2000-2015)



Source: MedCruise, 2016.

To accommodate this growth, cruise ports have to invest in modern facilities that are able to serve the needs of the new generation of cruise vessels and, not least, to handle the produced waste in a most efficient and effective way. On the one hand, cruise ports must comply with their applicable environmental laws and regulations in order to avoid enforcement actions by the responsible government agencies. On the other hand, the presence of societal pressures motivates them to develop 'greening' initiatives that go further than just the regulatory approach (Adams et al, 2009). A port authority might invest in improving its environmental performance due to the need to maintain its 'social license to operate', due to corporate conscience, and not least in order to achieve competitive advantage

Pollutants and waste from cruise ships include air emissions, ballast water, waste water, hazardous waste and solid waste. An average cruise ship generates a minimum of 1 kg of solid waste plus two bottles and two cans, per passenger per day and an average of 50 ton of sewage (black water) per day. A figure of 3.5 kg/passenger/day is quoted by the IMO (Butt, 2007). Based on the US Department of Transportation data, the estimated amount of generated waste (typical one-week voyage) includes 25,000 gallons of oily bilge water;

210,000 gallons of sewage (or black water); 1 million gallons of non-sewage wastewater from showers, sinks, laundries, baths, and galleys (or grey water) and eight tons of solid waste (i.e. plastic, paper, wood, cardboard, food, cans, glass) (Table 1).

The average cruise ship of 3,000 passengers and crew generates about 50 tons of solid waste in a single week. These vessels, or the ones with double capacity (i.e. the Royal Caribbean Oasis class vessels that exceed capacities of 6.000 passengers) cruise with a capacity utilisation that exceeds 90%, thus produce significant wastes and residues to be delivered at the cruise ports they visit.

Table 1: Summary of Cruise Ship Waste Streams

Type of waste	Estimated amount generated (typical one-week voyage)	Content/type
Sewage (black-water)	210,000 gallons	Waste water and solids from toilets.
Gray-water	1 million gallons*	Wastewater from sinks, showers, galleys, laundries. Contains detergents, cleaners, oil and grease, metals, pesticides, medical and dental wastes.
Hazardous wastes	110 gallons	Photo chemicals.
	5 gallons	Dry-cleaning waste (chlorinated solvents).
	10 gallons	Used paint.
	5 gallons	Expired chemicals, including pharmaceuticals.
	Unknown	Other wastes, such as print shop wastes.
		Used fluorescent and light bulbs.
		Used batteries.
Solid waste	8 tons	Plastic*, paper, wood, cardboard, food, cans, glass.
		Under international regulations, the discharge of plastics is prohibited.
Oily bilge water	25,000 gallons	Liquid collected in the lowest point in the boat when the boat is in its static floating position.

Source: MARAD (2002).

Overall, a considerable part of the solid waste generated by shipping comes from cruise ships. In the absence of recent data, it is worth noting that two decades ago the share of the comparatively lesser cruise activities was measured to stand at approximately 24% of the total wastes produce (see: National Research Council, 1995). Under MARPOL and the EU PRF Directive, ports are obliged to provide adequate port waste reception facilities with no undue delay of the ship.

4. PRF in Mediterranean Cruise Ports

4.1 Research Methodology

An online survey was contacted aiming to identify the availability, practices, and operations of port reception facilities with reference to the revised MARPOL 73/78 - Annex V requirements in cruise ports geographically located in the Mediterranean Sea.

The questionnaire is structured in two main principles. The first one is to obtain input regarding the port reception facilities available at each answering Mediterranean cruise port in relation to garbage delivered by ships as defined in the revised MARPOL Annex V. The second one is to compare the answers provided and draw conclusions regarding the overall state of management practices as regards ship generated garbage at the surveyed/orts.

To achieve these aim, the questionnaire followed - in principle - the structure of the waste reception and handling plan that each port must submit in line with the existing regulatory framework, as well as the guidelines provided in MARPOL regulations. In this way, the responding ports were familiar with the questions, thus the information required could be easily collected and reported.

The four thematic areas of the questionnaire are:

A. *Waste Reception Services:* This section refers to port reception facilities used for collecting the garbage from the ship.

B. *Handling Services:* The handling services are divided into two groups with the first one to include services prior to the disposal while the second one includes the garbage disposal services. It refers to the disposal services of the port reception facilities.

C. *Administrative Framework:* The Framework applied for the proper execution of the waste reception and handling.

D. *Charging Services:* The fees applied for garbage reception and handling services also including exemptions available. By exemptions, we mean the special regulations applied at each port, defining the cases in which the ship is not obliged to deliver garbage e.g. it will not deliver because the next port is in an “acceptable” distance, there is space in the ship (based on the garbage book) thus it is not “suspicious” that will dump garbage in the sea.

The questionnaire was distributed electronically to all cruise ports members of MedCruise. In total we received replies from 40 port entities (54,8% of the sample), representing 52 cruise ports in the Mediterranean seas. Based on MedCruise statistics (MedCruise, 2016), these entities (listed in Table 2) hosted in 2015 14.778.664 passenger movements, representing approximately 44% of the total cruise calls in all cruise ports of the Mediterranean region and its adjoining seas.

Table 2: The port sample (passenger movements, 2015)

Port (port entity)	Pax in 2015	Port (port entity)	Pax in 2015
Barcelona	2.540.302	Antalya	171.117
Venice	1.582.481	Brindisi	151.922
Piraeus	980.149	Cartagena	151.195
Tenerife	933.154	Azores	141.846
Dubrovnik / Korcula	830.684	Bodrum	70.038
Livorno	697.955	Koper	57.893
Valletta	668.277	Trieste	44.236
La Spezia	667.446	Palamos	40.800
Corfu	647.346	Thessaloniki	26.356
Madeira Ports	580.348	Alanya	22.321
Kusadasi	567.291	Antalya	22.321

French Riviera Ports	546.199	Sete	20.555
Lisbon	512.128	Sibenik	17.562
Malaga	419.121	Portimao	14.786
Valencia	371.374	Tarragona	11.600
Gibraltar	344.140	Rijeka	9.082
Cagliari	263.247	Odessa	6.563
Toulon-Var Provence	240.833	Motril-Granada	6.481
Heraklion	219.805	Huelva	4.788
Cyprus Ports	173.309	Ceuta	1.613

4.2 Port Reception Facilities, Segregation, Disposal

The surveyed cruise ports maintain facilities that receive all garbage types defined in revised Annex V of MARPOL. These are plastics, food wastes, domestic wastes, Cooking oil, Incinerator ashes, operational wastes, cargo residues, animal carcass, and fishing gear.

Minor differences are noted however when the different types of garbage types are under consideration. The survey revealed that 77,8% of the Med cruise ports receive plastics and food wastes, 72,2% of the total receive incinerator ashes, operational wastes and cargo residues, whereas 61,1% receive domestic wastes, animal carcass and fishing gear.
As regards the location where the available garbage reception facilities can be found, it is important that in the case of 88% of the surveyed ports garbage reception facilities available at all berths. In the case of another 4% such facilities are provided ‘at most berths’ and the rest 8% offers them ‘at some berths’. As regards the working hours of PRF, in almost all ports cruise vessels can use them when calling a cruise port in the Med 24 hours, seven days per week. A total of 96% of the surveyed cruise ports fall within this category, whereas all the rest provide PRF during the working hours of each day of the week.

Different types of garbage need different type of handling facilities. Trucks, containers, vessels and skips are the most commonly garbage reception facility. Special vessels and containers are also used, while the least commonly used facilities are barrels, packages, drums, bags and pipes (Table 3). Containers are the basic storage facility in most ports for all types of garbage, expect cooking oil, whereas liquid tank is the most appropriate type of storage. Other types of storage include skips and platforms, but these are less used.

Table 3: Facilities used per type of garbage

	Plastics	**Food Wastes**	**Domestic Wastes**	**Cooking Oils**	**Incinerator Ashes**	**Operational Wastes**	**Cargo Residues**	**Animal Carcass**	**Fishing Gear**
Truck	✔	✔	✔	✔	✔	✔	✔	✔	✔
Container	✔	✔	✔	✔	✔	✔	✔	✔	✔
Tank	✔	✔	✔		✔	✔			
Forklift	✔	✔	✔	✔					
Vessel	✔	✔	✔	✔	✔	✔	✔	✔	✔
Cages	✔	✔	✔		✔	✔	✔	✔	✔
Barge	✔			✔	✔				

Skip	✔	✔	✔	✔	✔	✔	✔	✔	✔
Dumpster		✔							
Plastic IBCs				✔					
Barrels				✔					
Packages				✔					
Drum				✔					
Bags					✔				
Pipes							✔		

Two out of three ports have storage facilities inside their port area (Figure 3). The most common garbage types that are stored inside the ports area are plastics and domestic wastes while less common are animal carcasses (13%) and fishing gear (19%). As Figure 4 details, different types of storage facilities exists for the treatment of ach type of waste and cargo residues.

Figure 3: Availability of storage facilities inside the ports per garbage type

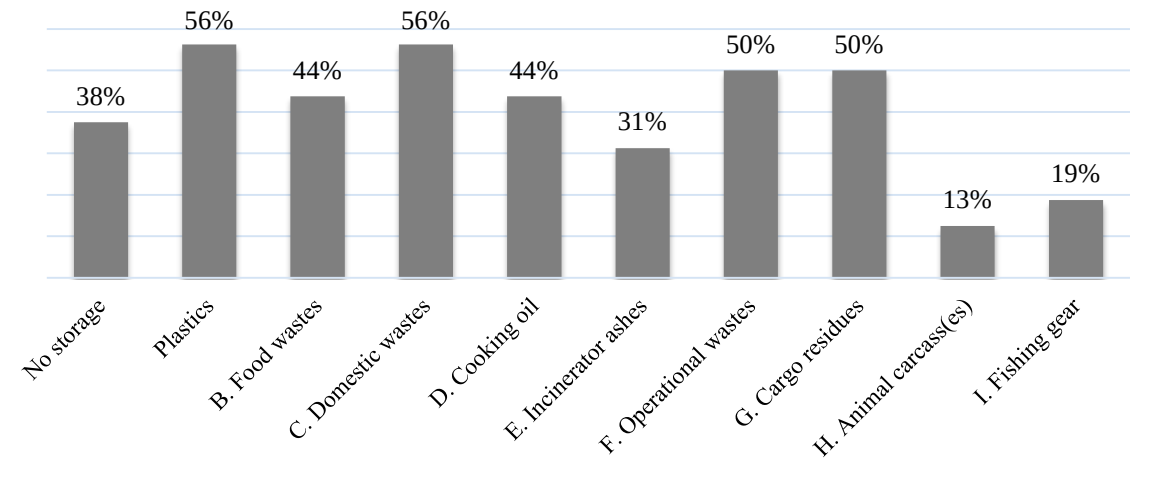
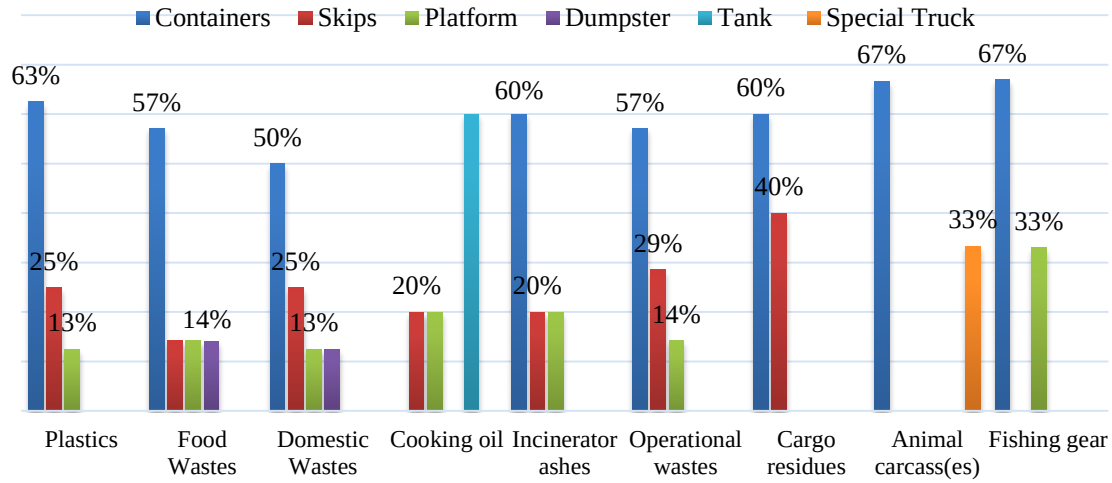


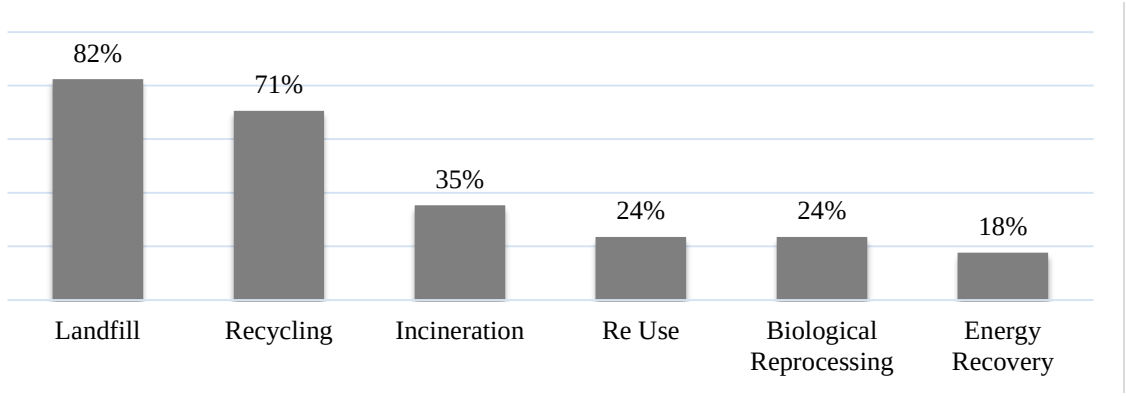
Figure 4: Type of storage facilities per garbage type



More than half of the cruise ports, a total of 58%, do not offer segregation services prior to waste disposal. This happens, to a large extent, because ports have typical assigned this type of services to external contractors. These contractors transfer the garbage in their premises, where the segregation is taking place prior to disposal. Similar to the segregation services prior to disposal, the vast majority of cruise ports (81%) do not offer treatment services prior to disposal.

Landfill and recycling are the most used disposal methods existing in the 82% and 71% of replying ports, respectively. Incineration (35%), re-use (24%), biological reprocessing (24%) and energy recovery (18%) are the mostly selected for specific types of garbage categories (Figure 5).

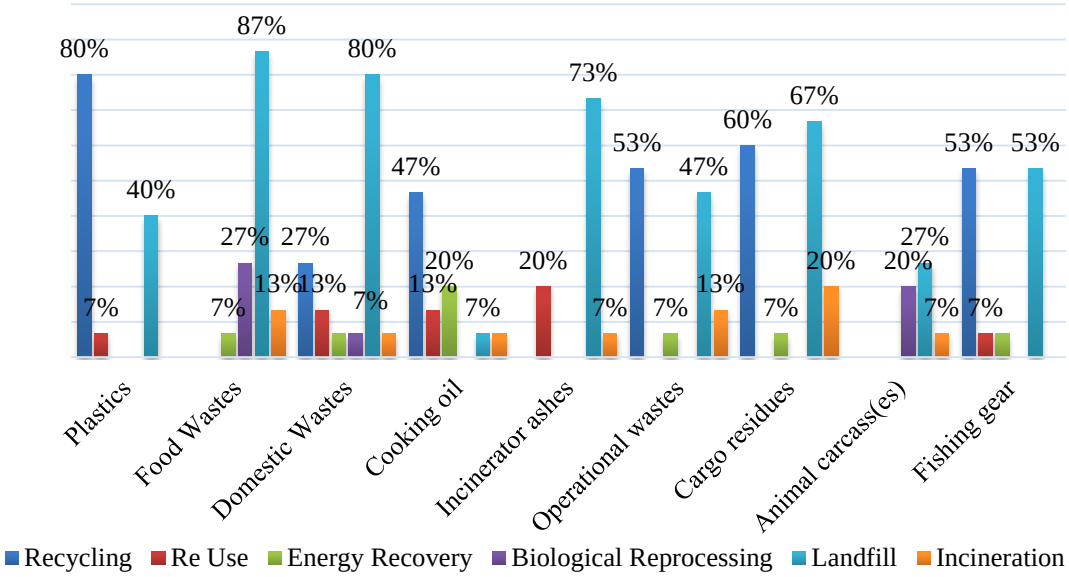
Figure 5: Garbage disposal methods



Landfill is used mostly for domestic and food wastes while recycling is the dominant disposal method for plastic garbage - 80% of Mediterranean cruise ports recycle plastic garbage. Incineration is used in all garbage with the exception of plastics. Re-use is also applicable to five garbage types, namely plastics, domestic wastes, cooking oil, incinerator ashes and fishing gear. Biological processing is another method used by cruise ports, mostly in the case of food wastes (in 27% of the ports), animal carcasses (in 20% of the ports), and to a lesser extent (7%) in the case of domestic wastes (Figure 6).

The most common practice and related technology that is used by cruise ports as preparatory activitt for disposal or/and for use of the treated garbage in case of reuse, energy recovery, etc., and are applied prior to recycling, is segregation. Segregation takes place outside the port premises, specifically in dedicated plants. When incineration is used the ashes are re-used in the cement industry. As regards biological reprocessing, which is applied mainly in animal carcasses and food waste, these are processed for inactivation and composting. The landfill disposal method is used when no other method can be applied and the waste is not dangerous. In general, cruise ports follow the rules of the municipal waste management plan. When asked about the energy recovery disposal method the replying ports reported that there are not such practices in place.

Figure 6: Garbage disposal methods per garbage type



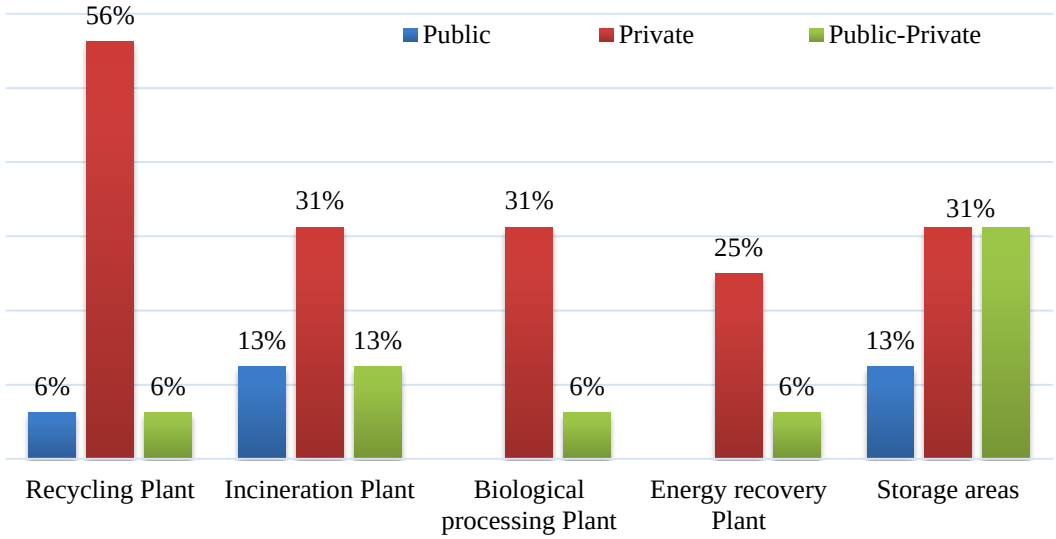
4.3 Administrative Issues and Fee Selection Schemes

The available waste port reception facilities are under different proprietary status. This status is typical based on the specialization. In the case of all waste reception facilities private ownership is dominant. Yet, the degree that this happens in each case is different. In the case recycling plants, 56% of the available facilities are privately owned. This percentage equals to 31% in the case of incineration and biological plants, and storage areas, and 25% in the case of the energy recovery plants. Comparing to the other PRF, the public proprietary status is comparatively high (31%) in the case of the storage areas. Most important is the fact that the biological processing and energy recovery plants are not public owned in anyone of the ports participating at the survey (Figure 7).

A fourth important issue examined are the fee selection schemes that are in place. The European PRF Directive requests cruise ports to establish cost recovery systems to encourage the delivery of waste on land and discourage dumping at sea. In line with the Directive, all ships calling at a member state port should bear a significant part of the cost whether they use the facilities or not. The European Commission interprets this ‘significant part’ as meaning at least 30% of the costs. This cost recovery system comprises the mentioned built-in, a fixed element and, possibly, a variable element according to the amount and type of waste actually delivered.

In practice, the most commonly applied fee selection scheme is that of collecting indirect fees irrespectively of the actual use of the facilities. The direct fee selection scheme is applied at almost one quarter of the ports while the remaining apply a combination of direct and indirect fee scheme (32%). Less than 10% of the surveyed cruise ports apply a flat compulsory minimum fee. Thresholds apply in the case of 3 out of 10 ports; when delivered waste exceeds specific quantities there is an extra charge.

Figure 7: Proprietary status of PRF



Given the remarkable variance of the fee payment methods, it is worth focusing on the main principles of the fee selection schemes applied at five major ports from different countries.

The first case is that of Barcelona, the major cruise ship in the Mediterranean Sea. In Barcelona, cruise ships pay a fixed waste tax per call. A private company provides the service requested by ships and the Port Authority of Barcelona is responsible for the payment of the services provided.

In the case of Venice, the fee selection scheme in place is based on the division of the respective fees into two different types of rates. The first type is a fixed rate that covers the costs necessary to carry out the collection and disposal service, by ensuring coverage of at least 35% of the fixed costs. The current legislation requires the payment of this fee even from vessels that do not discharge waste at the Port of Venice. The second one is a variable rate that covers costs directly related to the actual delivery of wastes based on tonnage. This variable rate is also subdivided in hourly rate, a fee per cubic meter, and a fee for the service provided.

In the cruise port of Dubrovnik ships are charged different fees based on the type of waste. The disposal of solid waste has an obligatory fee based on the ship gross tonnage. Ships that are less than 500 grt pay a fixed fee and those over 500 grt pay a fee based on the quantity of the disposed waste. Other wastes received are fluid wastes and oil waste, with the charging is per quantity for both disposals.

In Kusadasi all cruise ships vessels are subject to a compulsory contribution fee that is designated according to gross tonnage of the vessel. This compulsory contribution fee allows each vessel to deliver a certain amount of waste (m^3) without any charge while it is charged any additional m^3 of garbage.

Two categories of waste fees applied to cruise ships calling Piraeus. The first one is a contributory fee that covers the delivery, treatment and final disposal of a maximum

permitted quantity of waste per ship call. This fee apples to cruise ships whose deployment includes frequent and regular calls at the port of Piraeus, i.e. those realising a minimum of three calls per month. The second type of fee is a fixed fee per call. This applies to cruise ships without scheduled traffic, and is structured to cover the food waste and the domestic waste only. For the operational waste, as well as for exceeded quantities of domestic waste that are not covered by the contributory fee the additional applicable charge depends on the waste quantity.

An important issue is the insufficient cost incentives to deliver to PRF. The EU PRF Directive requires that the ships contribute to the facilities via an 'indirect contribution' (minimum 30% of the cost) which is irrespective of their actual use of those facilities, and stands as an incentive not to discharge their waste into the sea. The different application of this incentive has resulted a large variety of cost recovery systems for charging port users for the delivery of waste to port reception facilities, including different systems for different types of waste.

In monetary terms, the majority of the cruise ports in the Med (55%) apply fees standing between 50-100 € per m^3. In the case of 9% we recorded a fee that exceeds 100 €, while in the rest 36% of the surveyed ports this fee is less than 50-100 € per m^3.

Three other interesting conclusions are reached by the input provided by cruise ports. The first one is that there are ports that have a flat rate up to a maximum quantity, and thereafter they apply extra charges for exceeded quantities. In this case the extra fees are almost double compared to the unit price of the flat rate. The second one is that there are not significant differences on the fees in relation to the garbage type. The final one is that there are lower fees when the garbage is delivered segregated rather than otherwise.

5. Conclusions

With environmental issues standing among the key issues for sustainable port development, this study focused on the implementation of international and European regulatory frameworks in the case of a rather understudied port market (see contributions in: Pallis et al, 2014), that of cruise ports.
Port related environmental issues have been an integral part of the EU initiatives since the early days of the port policy (i.e. Chlomoudis and Pallis, 2002). This growing interest in addressing such issues produced specific environmental regulations associated with particular problems, and contributions to sustainability. These rules imply a call for port authorities to expand their strategies and practices in order to comply and achieve sustainable growth.

The previous sections detailed the findings of a survey regarding the availability, the practices, and the operations of PRF with reference to the international and European regulatory requirements in place. The target was to realise the extent that port authorities have worked to comply with the Annex V of the IMO MARPOL Convention and, when applicable, the EU PRF Directive. With cruise activities contributing substantially to the growth of the ports they call and the prosperity of the destinations they reach, it is important to secure cruise port infrastructure and related port services that would allow existing calls to grow. The existing waste reception facilities need to be such that the ship-shore interface does not stand as an unexpected break in the process of waste handling that the regulatory framework has foreseen.

On the one hand, the answers of over 50 cruise ports produced a database of ashore waste reception and disposal facilities demonstrating the presence of a satisfactory state of PRF in the Med, with a variety of options – either operational ones or pricing schemes – available to cruise vessels. On the other hand, this variety should be treated with caution. Effective coastal zone management requires regulations of various forms. It can be advocated – similarly to de Langen and Nijdam (2007) who proceeded to the examination of port reception facilities in the case of cargo ports in North Europe - that the applied charging systems for waste reception facilities in ports need to be such that secure a level playing field. Applicable regulations and respective implantations should be developed in such a way that the playing field between ports remains level, while substantial differences in the charging systems for waste disposal might distort the playing field. Whenever exists distortion puts pressure on ports not to introduce the most environmentally friendly charging system. Thus, policy makers need to identify policy options to align the need for protecting the marine environment with the need to ensure a level playing field.

When European institution continue to discuss the update of the PRF Directive, the output of this survey provides also the background for the introduction of a port waste information management system based on a database where the current management practices of cruise ship generated garbage are presented. Such information system might act as a one single point of reference of the cruise industry, given that interested cruise line would easily find the port reception facilities provided at each port. Among others, the knowledge of the available disposal facilities allows the educated choice of all the cruise ships sailing in the region under examination. It also prevents the waste of existing regulated garbage streams. Once provided environmental impacts and available technologies for the specific waste stream recycling, re-use, energy recovery or disposal at each port, a cruise ship is able to plan its waste dumping in the most proper way. Yet, such database does not currently exist and each cruise line needs to collect this information by itself, multiplying in this way the efforts but also limiting the potential of reaching an optimized waste management.

The findings of the survey enable to overcome this deficiency. If repeated in the future, comparisons of findings will result in a much-needed port waste information management system and, not least, establish an on-going communication channel with relevant port authorities that could allow a progressive strengthening of the public and private commitment to sustainable growth.

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