Consideration between compliance of environmental regulations and saving the cost

Techcross Technical White Paper

Summary

It is well known that protecting the environment is essential for sustainable resource development and maintenance of daily life. However, the challenges faced by the industry to comply with the environmental regulations are more severe than expected because it means that a significant cost needs to be taken. In other words, in order to protect the environment while pursuing company's interest, comprehensive review of full costs is required beyond what has been done so far. Therefore, this white paper aims to provide insights in terms of cost, which is a major consideration for the ballast water management system to protect the marine environment.

TECHCROSS

Contents

Introduction

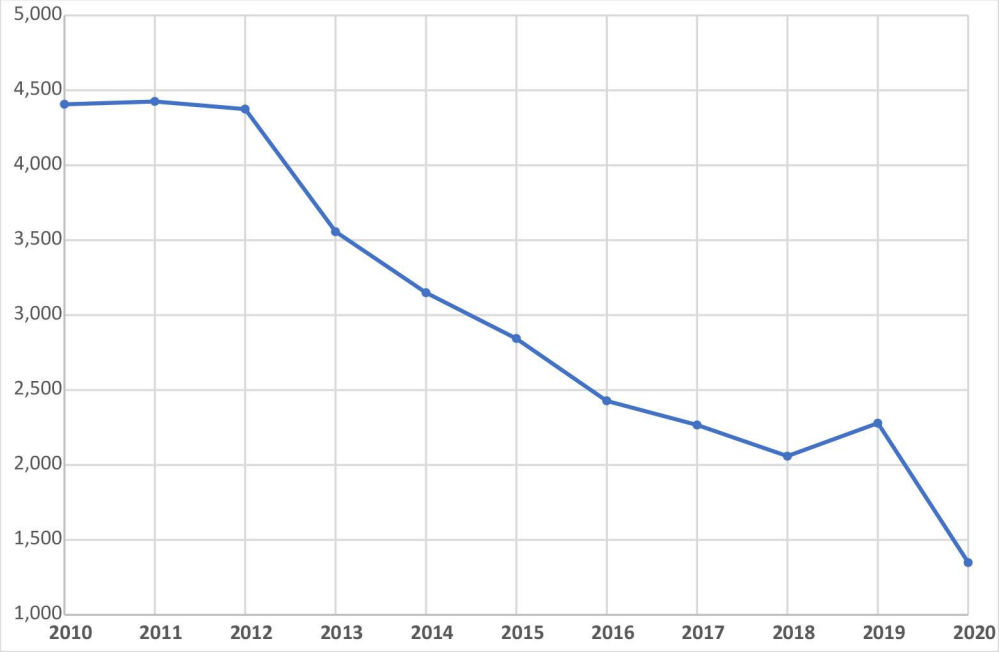

Figure 1. Orders taken for new ships by year

The shipbuilding industry, after a short prosperity after 2010, went into a long dark tunnel as the number of orders for new ships decreased suddenly due to oil price decline and global economic recession which began in 2013. Then last year, when it finally seemed to be getting out of the tunnel, the COVID-19 pandemic broke out in 2020, and the situation is being continued where we cannot be optimistic about. Among this, the International Maritime Organization has begun to accelerate an extensive environmental protection regulation called IMO 2020.

The IMO has adopted a greenhouse gas reduction strategy in 2018, reinforcing carbon emission regulations which aims 50% reduction in greenhouse gas emissions compared to 2008 by 2050, as well as sulfur oxide emission regulations on ships. Active movements for environmental protection deserve to be welcomed from the perspective of protecting the Earth's resources. However, it is difficult for the stakeholders who are actually managing ships to welcome this. While profitability is declining with contraction of global cargo transport due to the pandemic, they have faced a situation where additional environmental protection devices that were not needed before or designs for eco-friendly ships with higher technology are required. And as all of this means their burden of extra cost, the current situation is not pleasant for them.

Nevertheless, the shipbuilding industry stakeholders will have no choice but to swallow bitter drugs to comply with environmental regulations and for a sustainable living base for the future. The most important thing for them now is to be provided with an optimal solution that can satisfy the regulations with minimized costs. Therefore, this white paper summarizes the factors that can maximize the benefits of stakeholders when purchasing a ballast water management system among environmental protection devices. Particularly, a close investigation was conducted in terms of cost, which should be most importantly dealt with. Details can be found in the main body.

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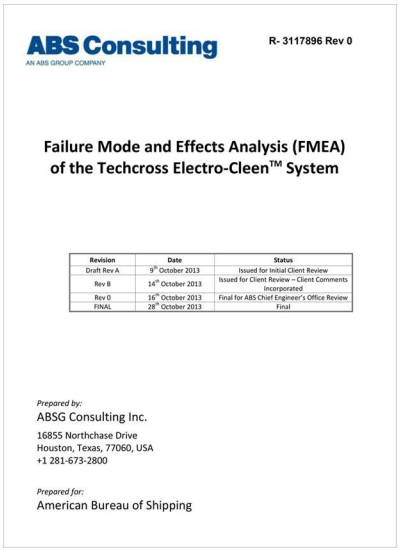
First criterion for selecting BWMS: Compliance with regulations

First of all, it is necessary to check whether the equipment comply with the environmental regulations specified by each organization. And satisfaction of the standards can be identified by 'approval'. Currently, the IMO, the governments of each country, and the classification society for ships have their own test regulations, providing type approvals to the equipment and companies that have passed the tests. Although there are differences in types of treatment technology for each approved equipment, it is reasonable to assume that there is no problem with the treatment itself if it owns the identical type approval.


ABS Consulting
AN ABS GROUP COMPANY

R- 3117896 Rev 0

Failure Mode and Effects Analysis (FMEA) of the Techcross Electro-Cleen™ System

Revision	Date	Status
Draft Rev A	9th October 2013	Issued for Initial Client Review
Rev B	14th October 2013	Issued for Client Review – Client Comments Incorporated
Rev 0	16th October 2013	Final for ABS Chief Engineer's Office Review
FINAL	28th October 2013	Final

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Figure 2. ABS FMEA Report (2013)

In addition to type approval, if the equipment has completed additional approval tests, its reliability increases. For example, Techcross ECS (Direct electrolysis) performed a Risk Assessment with ABS classification society in Houston, USA in 2013. In this assessment, HAZOP (Hazard & Operability), hydrogen gas safety test, and FMEA (Failure Mode & Effects Analysis) were performed. At that time, it was recorded as the first case in the ballast water management system industry to perform FMEA with the classification society. Such additional safety approvals from accredited organizations could be a sufficiently attractive factor.

Looking at the current state of USCG type approval acquisition, out of a total of 33 equipment, systems using chemical or pasteurization and ozone treatment and etc. are also noticeable, while electrolysis and UV sterilization dominate the majority. Technologies are inevitably diversified as they were developed using the representative technologies of each company. Each system has strengths and weaknesses, and it is better to select a system according to the customer's preference and the characteristics of ships.

People question the performance of equipment without filters, which is implemented by most of the equipment. However, in the case of Techcross ECS (Direct electrolysis), which is a representative equipment without filter, it obtained the USCG type approval equivalent to other equipment solely with electrode efficiency. (Refer to the previous Techcross white paper, 'Operational Limitation in BWM'.) Some mention power consumption, but this will be explained further in detail by the next section.

[1] Download through 'Support – Download' menu in Techcross website (www.techcross.com).

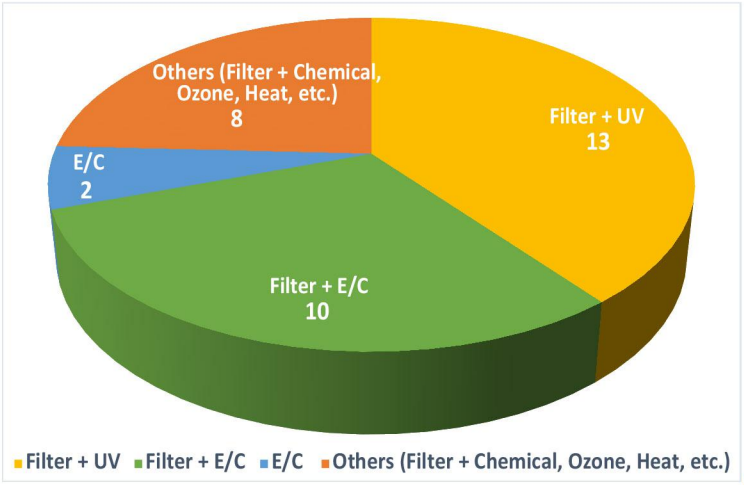

Figure 3. Current state of USCG type approvals for each BWMS technology (In 2020-12)

"Although there are differences in types of treatment technology for each approved equipment, it is reasonable to assume that there is no problem with the treatment itself if it owns the identical type approval."

Second criterion for selecting BWMS: Reasonable cost

Purchasing a ship supply is not just about purchasing action. The cost covering from purchasing to installing the equipment, as well as the maintenance must be considered. This is because there may be a ridiculous situation in which monthly maintenance cost exceeds the initial cost that after purchasing it at a low price. Therefore, we will look through the factors regarding the required cost and expenses from various perspectives.

1. Installation cost

Once purchased, equipment must be installed on the ship. The manpower, the installation space, and the retrofitting process for changing the ship structure are considered when installation of equipment. The best method of installation is to prepare space for equipment in advance at the design stage of a ship, but since the ballast water management system is required to be installed by 2024, it is inevitable to install the existing ships. In this case, it is the most important to resolve the time and space constraints so that there is no obstacle in ship voyage schedule. In other words, the simpler installation is, the more time, space and cost are saved.

Back to the Figure 3, consider the installation space of filters that are adopted by most systems regardless of treatment method. There are differences in size by manufacturer and capacity, but in general, the space required for filter installation is as follows.

"Since the BWMS is required to be installed by 2024, it is inevitable to install the existing ships. In this case, it is the most important to resolve the time and space constraints. In other words, the simpler installation is, the more time, space and cost are saved."

Capacity	Installation space (㎡)
150㎥/hr	0.52
500㎥/hr	0.68
1000㎥/hr	1.69
1500㎥/hr	3.17
2000㎥/hr	3.57
4000㎥/hr	5.61

Table 1. Rough values of installation space of filters per capacity

In addition, Figure 4 compares the installation space for major equipment by manufacturer. The calculation only involves the installation area for the major 2 components, filter and UV reactor in the case of UV sterilization method, and the installation area for the major 3 components, filter, hypochlorite generator, and neutralization unit in the case of the electrolysis method. Looking at the footprint of the major components for UV and electrolysis systems, it is found that the electrolysis method equipment generally requires more installation space and the only electrolysis method without filter, Techcross ECS (Direct electrolysis) takes up the least installation space.

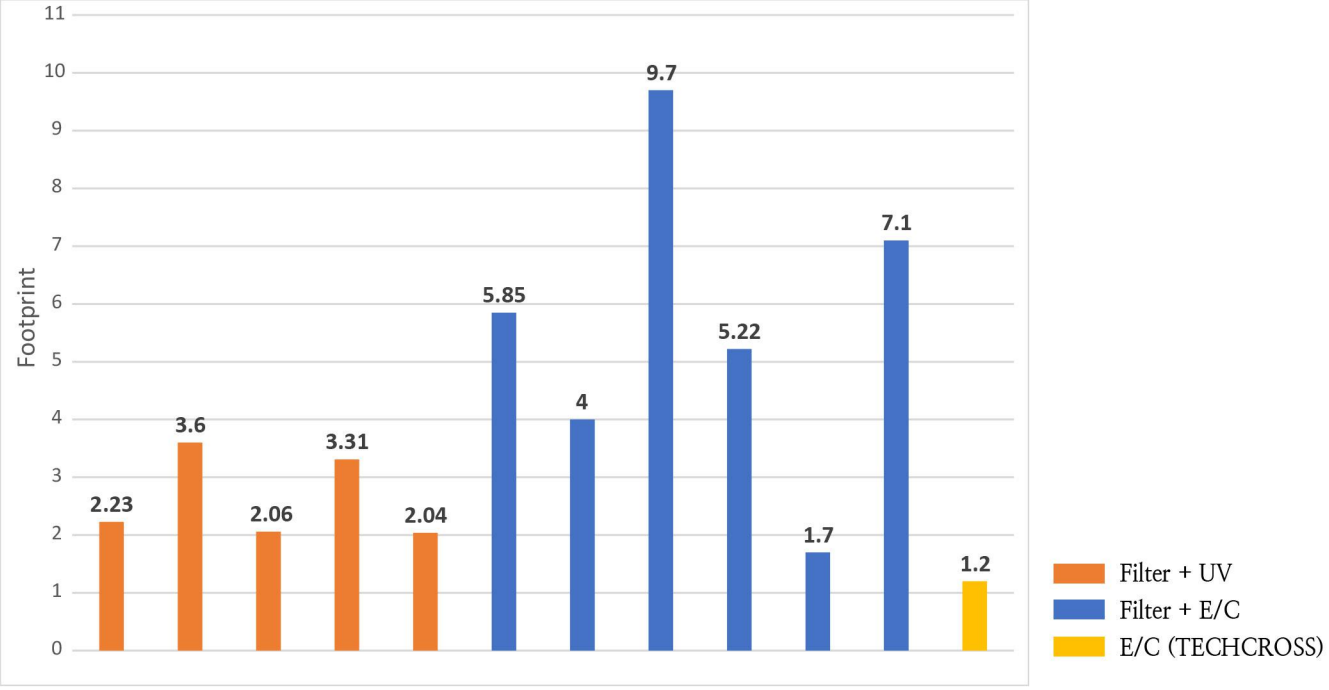

Figure 4. Installation space by equipment (by 500 tons) *UV method (filter, UV reactor) vs E/C method (filter, Hypochlorite generator, Neutralization unit)

In addition, there are other factors to be considered besides the installation space. It is the alteration of ship structure. Except for the hypochlorite generator in indirect electrolysis method, the remaining major equipment (filter, direct hypochlorite generator, UV reactor) must be installed directly in the main pipeline of the ship. In other words, depending on the number of equipment, a series of processes from cutting the main pipes, inserting and installing equipment, and finishing work are additionally needed.

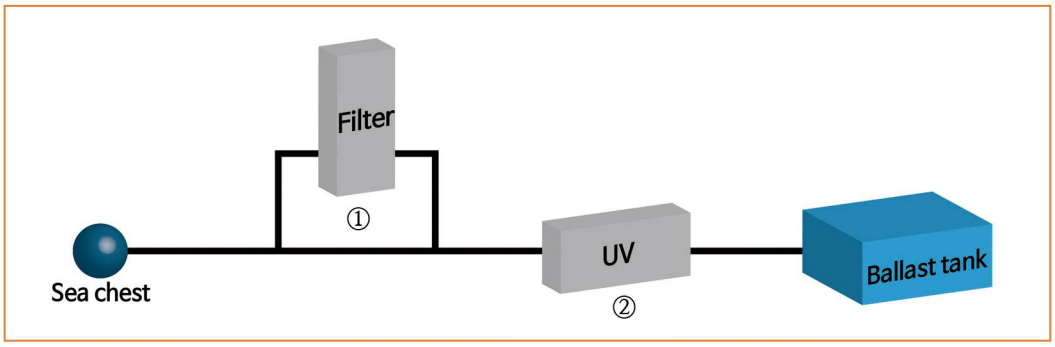

Figure 5. Diagram for UV disinfection system (2 pipeline works occur)

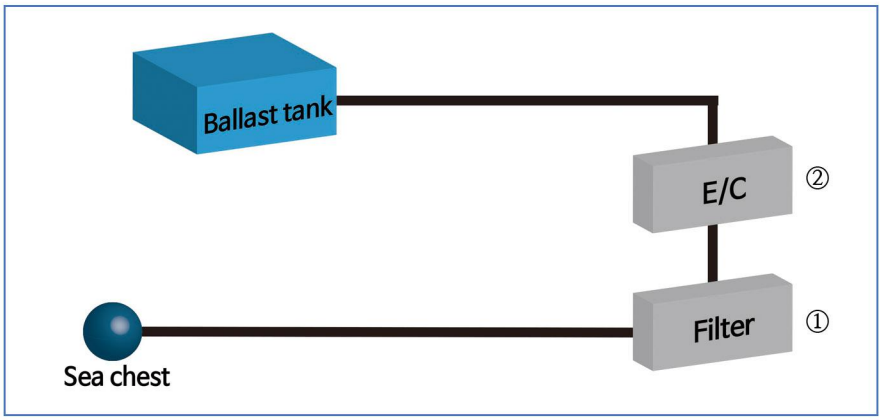

Figure 6. Diagram for direct electrolysis system (2 pipeline works occur)

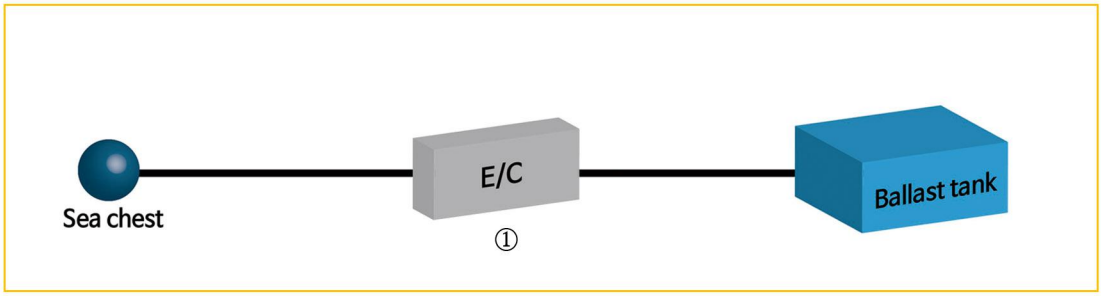

Figure 7. Diagram for direct electrolysis system of Techcross (1 pipeline work occurs)

According to the installation diagrams of the equipment, the difference is remarkable. As the work process becomes more complex, the manpower and time spent on the work increase proportionately, which directly relates to the cost. Therefore, it is reasonable enough that the less the number of equipment, the higher the competitiveness.

2. Operating cost

The ultimate intention of purchasing and installing an equipment is for use on the ship. In particular, because the life time of a ship is on average 30 years, the lower operating cost and maintenance cost of equipment, the better. Although purchasing and installation cost of equipment is relatively high, if the operating and maintenance cost of equipment are low in a long-term perspective, its efficiency is equivalent to purchasing cheaper equipment.

In general, comparison for the equipment operating costs is based on the power consumption during operation. Power consumption depends on the number of units and the treatment method. In addition, since there is difference in power consumption between seawater and freshwater, the environmental condition must be considered as well.

It can be said that the reason most manufacturers use filters even with the additional cost is to satisfy the performance reliably. Filters are used to filter out microorganisms and impurities larger than 50㎛ mixed in seawater before going through the main disinfection. Therefore, since only relatively small and weak microorganisms need to be treated in the filtered seawater, the hypochlorite generator or UV sterilization device in the next main treatment process is relatively easier. In other words, because easy treatment requires only lower power, it has the advantage of requiring less power consumption than equipment without a filter.

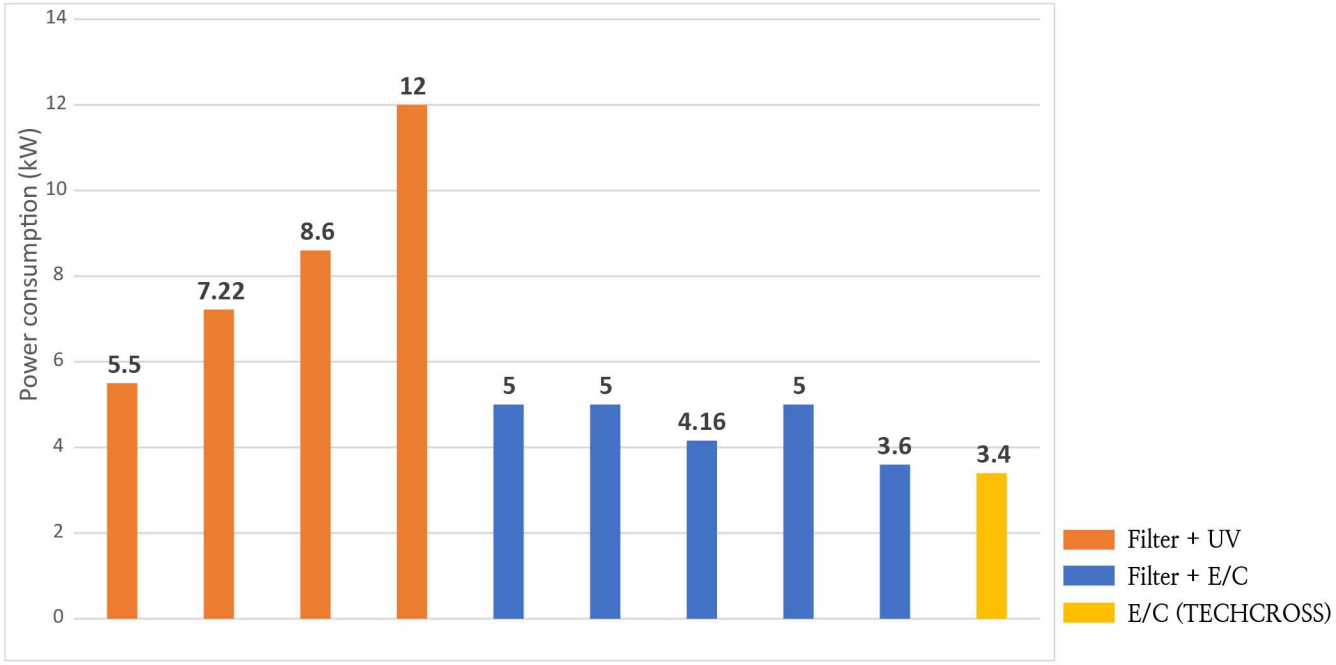

Figure 8. Power consumption by equipment (by 100 tons of seawater)

However, even if the power consumption in the main treatment process is reduced, the power consumption generated by the filter cannot be ignored considering the entire equipment. As shown in Figure 8, the ballast water management system of the UV disinfection method that requires operation of a UV lamp has a relatively higher power consumption, while Techcross which does not require a filter shows the lowest power consumption. The reason why its power consumption is similar to that of the equipment passing through the filter despite the absence of a filter is due to the self-developed high-end electrode. Techcross is able to save the power consumption as well as eliminate filter risks by maximizing performance through elaboration of electrode materials and unique coating method. If the performance meets the regulations without a filter, the filter that requires additional power will not have to be used. Additionally, considering the maintenance costs, which will be covered in the next section, it will be more skeptical about the additional equipment.

3. Maintenance cost

The maintenance cost is a factor to be considered same as the operating cost. The durability of the equipment is consumed as soon as the equipment is operated, and maintenance can help extend the durability for a longer. The actual operation of the ballast water management system is by one moment of the ship's entry and departure, but all other times are considered to be the area of maintenance, so the post-purchase management area is very important.

Increase in number of equipment in this situation is equivalent to the increase in area of maintenance. In particular, filters and UV reactors require special attention for maintenance.

In the case of filters, filter screens with sizes of 50 μm and 40 μm are generally used, but in some cases, filter screens as fine as 20 μm are used to increase disinfection efficiency. However, there is a problem that clogging may occur more frequently as the filter is denser. Usually, it is recommended to replace the filter screen every 1 to 3 years due to filter clogging and corrosion problems, but the cost of the filter screen is about 1/3 of the total price of the filter (see Table 2), and there is high replacement cost.

Capacity	Non-explosive proof type	Explosive proof type
150m³/hr	13,000	19,000
500m³/hr	19,000	25,000
1000m³/hr	36,000	42,000
1500m³/hr	54,000	67,000
2000m³/hr	67,000	83,000
4000m³/hr	107,000	128,000

Table 2. Rough price of filter per capacity for ballast water management system (by USD)

In addition, UV reactors have UV lamps according to the capacity of the ship. UV lamps are generally guaranteed 150 to 300 hours, and required periodic replacement after that. In particular, in the UV disinfection method, both ballasting and deballasting processes need to pass through a UV reactor to prevent the regrowth of microorganisms. In other words, the actual guarantee time of the UV lamp is nearly the half.

It is a big difference from Techcross ECS (Direct electrolysis), running the equipment only once during ballasting. The electrode, which is a core component of ECS, has an average life span of 8,000 to 10,000 hours, which is almost the same as the life time of a ship. Because of this, there is no additional cost to replace separate parts, all that is needed is to purchase neutralizers and reagents for TRO measurements. And even this is cheap enough to cost about USD 30 (neutralizer 12.5kg) and USD 80 (reagent 1 kit) and has the advantage of being easily available anywhere in the world.

Third criterion for selecting BWMS: AS services

Products are preferred to be able to use for a long time without troubles after purchasing. Even when a problem occurs, if an immediate action is possible, discomfort and disappointment of customers will be alleviated.

As over 10 years have passed since the BWM Convention was enacted, not only manufacturers but also users have better understanding of the product. And the more products are used, the more often they face the problems. Therefore, while product sales were the main purpose of each manufacturer in the past, now they are focusing on crew training and AS services. The following section briefly introduces the efforts for AS services of Techcross.

1. Efforts to improve equipment durability

Although prompt AS service is important, zero-defects equipment can solve all problems. Accordingly, Techcross runs its own reliability test laboratory to increase equipment durability. Most of the ballast water management systems sold in market are completing the equipment performance test only by obtaining approval from an external inspection organization. However, Techcross is focusing on quality control by establishing a self-inspection organization called a reliability test laboratory. The reliability test laboratory is equipped with separate equipment from expensive test equipment used by external inspection organizations to self-made test equipment tailored to Techcross BWMS. Utilizing this, we are conducting component durability tests and preliminary tests of newly developed equipment for cost reduction. Through these efforts, we can provide customers with robust equipment at reasonable prices.

Figure 9. Techcross reliability test laboratory

2. Expansion of global network

The users of ballast water management systems are moving around the world and they hope to receive services and materials quickly at any time and any place. As a result, Techcross has made great efforts to expand its global network from earlier on and is currently responding to the customer requests by cooperating with 5 overseas branches in Singapore, Japan, Netherlands, Cyprus, and the United States, as well as 40 partners in 25 countries. In addition, there is also a material warehouse at overseas bases, so necessary parts and materials can be shipped promptly.

In addition, training centers have been established in Korea, China, India, the Philippines (under installation) and Greece (to be completed in 2021), focusing on equipment education. Each training center has an actual ballast water management system installed so that the understanding of the equipment can be improved as much as possible. In particular, the training center located at the headquarters in South Korea was installed in an environment where pipeline was installed in the same manner as the ship environment, so that the actual seawater could be pulled during operation. Such efforts are effective in increasing the user's equipment familiarity, and in the event of a problem on board in the future, they have shown positive results in being able to solve problems on their own or easily respond to remote support with the headquarters.

Figure 10. Techcross material warehouse in the Netherlands

Figure 11. Techcross training center

What you need is the right BWMS with reasonable cost which is eliminated unnecessary elements

We have so far reviewed the items to be considered when purchasing the ballast water management system. We particularly looked over in terms of cost, but a way to save cost is eventually to eliminate unnecessary elements as much as possible.

Design only with core units without unnecessary items if possible, choose stable equipment to avoid incurring extra maintenance costs, and finally to find a reliable company that can smoothly receive AS service. When all of these are satisfied, customers will realize true value in terms of cost and the satisfaction after purchasing the product will be maximized.

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