

# UV-Transmission

Selecting the right ballast water treatment system

## Limitations of Ballast Water Treatment Systems

It should be acknowledged that ALL BWTS have limitations. Typically, chemical systems (e.g. electro-chlorination) have limitations related to the salinity of the water to be treated, its temperature or the amount of organic material contained therein, whereas UV-based BWTS have limitations with regards to the UV-Transmission of the water to be treated. In other words, all BWTS have special circumstances under which they cannot be expected to treat the water according to the IMO discharge standard. The trick for the ship owner then becomes to select a BWTS that will work under normal operational conditions. However, this choice is currently difficult to make due to lack of information from makers of BWTS, and consequently lack of transparency.



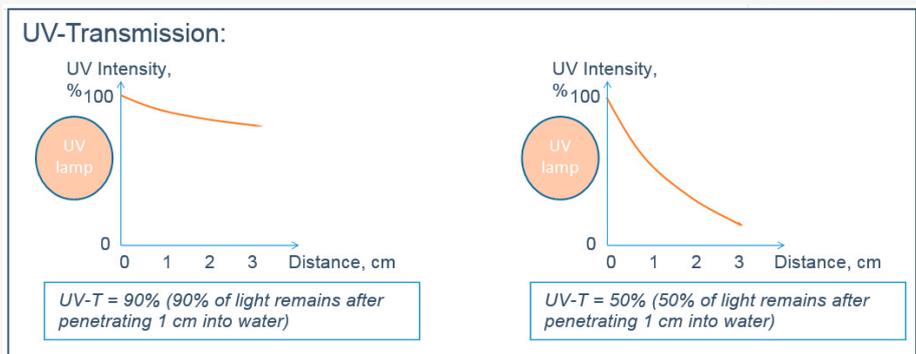
## What is UV-Transmission?

UV-T is a measure of the capability of UV light to penetrate into the water. When the UV-T is high, close to 100%, the water is very clear and the UV light can penetrate deep into the water. On the other hand, when the UV-T is low (below 50%) the water is very un-clear and the UV light can only penetrate a limited distance into the water.

In the figure two cases with different UV-T are illustrated; one case with high UV-T of 90%, and one case with just 50% UV-T. In the graphs (table 1 next page) it is illustrated how rapidly the UV intensity decays away from the UV-lamp.

With a UV-T of 90% the UV intensity is 81% 2 cm away from the UV lamp, whereas it has dropped to a UV intensity of just 25% 2 cm away from the lamp when the UV-T level is 50%. See also table on the back page.

Clearly, the UV-T of the water to be treated is of



utmost importance. To render an organism non-viable a certain UV-dose is required, and the applied UV-dose is directly proportional to the UV intensity. Therefore, when the UV-T is low, significantly more UV-power is needed to treat the water according to the required discharge standards, than what is required when the UV-T is high.

Distance from UV lamp [cm]	UV-T = 90% UV intensity [%]	UV-T = 50% UV intensity [%]
0	100	100
1	90	50
2	81	25
3	72.9	12.5

Table 1

### UV-Transmission of ballast water

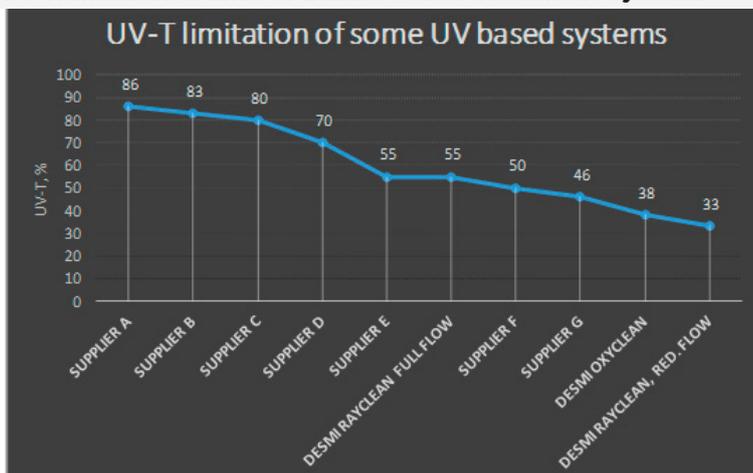
The UV-T found in different ports around the world varies significantly. Some ports are located at river estuaries which means the water in the port is fresh water containing high amounts of sediments, organic particles and dissolved organic compounds. This makes the UV-T very low. Other ports are located on islands in the middle of an ocean, and here the UV-T is typically high. See examples (table 2).

Port	UV-T
Shanghai, China	49
Vera Cruz, Mexico	94
Houston, USA	74
New Orleans, USA	54
Shanghai, China	55
Hong Kong, China	80
Antwerp, Belgium	66

Table 2

*Measured on two different days and two different locations in Shanghai port*

### UV-Transmission limit of Ballast Water Treatment Systems



As mentioned all BWTS have limits, and all UV-based BWTS has a limit regarding the UV-T they can cope with. From the above it can be seen that UV-T in ports around the world typically vary between 93% to 49%, and sometimes the UV-T is even lower and can in extreme cases be as low as 35%.

It is therefore crucial that a UV based Ballast Water Treatment system can cope with these UV-T levels. However, reality is that only a few of the type approved systems on the market are able to do this. Some manufacturers do not disclose their UV-T limitation, which is a concern. Others do and a comparison

between the DESMI Ocean Guard systems, RayClean™ and OxyClean™, and other type approved systems are shown in above graph.

### UV-Transmission limit of DESMI Ballast Water Treatment Systems

Only a few systems can cope with UV-T level below 50%. The DESMI systems can and sets the industry benchmark regarding UV-T limitation. The RayClean™ system holds the absolute record with a UV-T limit at just 33%. This remarkable performance is a result of the UV unit design and the unique capability of reducing the flow in extreme cases. The RayClean™ system constantly monitors the UV intensity inside the UV unit, and if it is lower than a certain threshold, the flow through the unit is automatically reduced. This ensures compliance with IMO and US Coast Guard discharge standards at all times, and even in extreme cases where no other system on the market can treat the water. In reality this flowreduction is only rarely utilized. The table show how the flow through one 300 m<sup>3</sup>/h RayClean™ UV unit is reduced at different UV-T levels.

Port	UV-T [%]	RayClean UV unit flow [m <sup>3</sup> /h]
Shanghai, China	49	250
Vera Cruz, Mexico	94	300
Houston, USA	74	300
New Orleans, USA	54	300
Shanghai, China	55	300
Hong Kong, China	80	300
Antwerp, Belgium	66	300
Lisbon, Portugal	53	295

*Measured on two different days and two different locations in Shanghai port*

The result is that the RayClean™ system is capable of handling extreme cases that no other system on the market can handle, and at the same time the power consumption of the RayClean™ system is the lowest on the market. This is possible because the superior performance is achieved without over-dimensioning the system, but just making the system “smart”, so that it automatically adjusts itself to the circumstances.