

Discharge water Improvement programme

Marine Aquatic Limited have been requested to submit a proposal for a treatment plan to the discharged water to sea well on site as part of the environmental permit held by Marine Aquatic Limited, for its discharge to sea from emission points ED1, ED2, ED5 and ED7. The request was as below:

This shall also outline a treatment plan including measures that will be taken to reduce concentrations of all tested parameters to below the limits as specified in Table 2.1.3, as well as the timeframe within which this will be achieved.

Table 2.1.3: Emission limits to the marine environment			
Emission point reference	Parameter	Limit	Frequency
ED 1	pH	6-10	Minimum of 3 sampling exercises with replicates per annum, taking into account seasonal and operational variations.
	Salinity	N/A	
	Temperature	40°C or 5°C above ambient, whichever lowest	
	Total Nitrogen	10 mg/L	
	Ammonium	N/A	Sampling with replicates shall take place in winter, summer, and summer peak.
	Orthophosphates	N/A	
	Total Phosphorus	1 mg/L	
	COD	125 mg/L	
	BOD	25 mg/L	
	Total suspended solids (TSS)	35 mg/L	
ED 2	Temperature	5°C above ambient at outlet	Minimum of 3 sampling exercises with replicates per annum, taking into account seasonal and operational variations. Sampling with replicates shall take place in winter, summer, and summer peak.
ED 5	pH	6 - 10	Minimum of 3 sampling exercises with replicates per annum, taking into account seasonal and operational variations.
	Total residual chlorine	0.3 mg/L	
	Total suspended solids (TSS)	35 mg/L	
	Temperature	5°C above ambient at outlet	Sampling with replicates shall take place in winter, summer, and summer peak.
ED 7A	Temperature	5°C above ambient at outlet	Minimum of 3 sampling exercises with replicates per

	pH	6 - 10	annum, taking into account seasonal and operational variations.
	Total dissolved solids (TDS)	N/A (mg/L)	
	Salinity	N/A (psu)	Sampling with replicates shall take place in winter, summer, and summer peak.
	Dissolved oxygen	N/A (% Saturation O ₂)	

Treatment plan proposal

Each of the parameters listed in Table 2.1.3 that has a limit within which the parameter must be before this is discharged in the corresponding emission point, has been analysed and ways to reduce this concentration have been listed. As seen from the below charts, a lot of treatments have already been implemented, and this is reflected in the results of the analysis done, where infringements are very rare. The treatment plan proposed will further ensure that these infringements are eliminated completely.

For each emission point a description of how it receives, processes and discharges the water will be given to understand better the process, and then the treatment plan for each parameter will be described.

ED1: Exhibit and Quarantine livestock tanks

The discharged water from all the aquarium tanks is diverted to a holding tank. The water in this holding tank thus must be within very tight chemical and bacteriological limits so that the fish are in a good state of health. The water quality in the aquarium tanks is guaranteed by the in-house aquarists that monitor it daily and/or weekly according to their set schedule. Three times a year an audit is done on the aquarium procedures including the way water is treated and tested. The holding tank has a dedicated sand filter continuously circulating the water withing, which also has an inline UV lamp.

Parameter	Limit	Action	Time frame
pH	6-10	95% of the reject is sea water which has a normal pH value of 8. The pH is measured weekly in the aquarium tanks to guarantee the pH value as needed. Thus, the discharged water to the holding tank is already measured for pH	Implemented
		A daily pH reading of the holding tank will be taken and recorded to confirm that limits are not exceeded	October 2024
Temperature	5°C above ambient	The aquarium tanks water is held between 18 - 27°C. Thus, the water in the holding tank will never go above this temperature. Also, since it is held for some time within the holding tank, the water goes down to ambient temperature.	Implemented

		A daily temperature reading of the rejected water will be taken and recorded to confirm that limits are not exceeded	October 2024
Total Nitrogen	10mg/L	The holding tank has a dedicated sand filter circulating the water which reduced the nitrogen dissolved in the water.	Implemented
		The holding water tank is to be dosed with Ozone gas to oxidize nitrogen compounds into nitrogen gas, which can then be removed.	December 2024
Total Phosphorus	10mg/L	The holding tank has a dedicated sand filter circulating the water which reduced the phosphorus dissolved in the water.	Implemented
		Addition of activated carbon filters to absorb both particulate and dissolved phosphorus	To be implemented if limit values exceeded
COD	125mg/L	The holding water tank is to be dosed with Ozone gas which can oxidize compounds, reducing COD	December 2024
		Addition of activated carbon filters can effectively remove compounds contributing to high COD	To be implemented if limit values exceeded
BOD	25mg/L	The holding water tank is to be dosed with Ozone gas which can oxidize compounds, reducing BOD	December 2024
		Addition of activated carbon filters can effectively remove compounds contributing to high BOD	To be implemented if limit values exceeded
Total suspended solids (TSS)	35mg/L	The holding tank to allow suspended solids to settle out of the water. The water can be left to sit in the tank for a period, allowing the solids to settle to the bottom.	Implemented
		The holding tank has a constantly dedicated sand filter circulating the water which reduced the phosphorus dissolved in the water.	Implemented
		The holding tank to be cleaned every six months from the deposited solids at the bottom.	December 2024

ED2: Cooling water (sea water) from chillers

The air conditioning system withing the aquarium complex and the cooling of the aquarium tanks is done through circulation of chilled water. The chilled water is produced by two separate chillers that are cooled using sea water extracted from a borehole. The sea water extracted from the borehole passes through a heat exchanger, cools a secondary water and is discharged directly in E2. The sea water and the secondary water do not mix during this process and so the water is not chemically or biologically modified but only heated to a few degrees. The cooling process is achieved by a huge amount of water circulated.

Parameter	Limit	Action	Time frame
Temperature	5°C above ambient	The temperature of the discharged water is dependent on the load of the chillers. To reduce the water temperature the load of the chiller must be reduced. The percentage reduction should be dependent on the ambient temperature.	To be implemented if limit values exceeded
		A daily temperature reading of the rejected water will be taken and recorded to confirm that limits are not exceeded	October 2024

ED5: Pool backwash

The two pools at Café Del Mar which is part of the Malta National Aquarium complex have a set of three filters each to keep the water to the best possible quality. The pool water is tested and recorded twice daily to guarantee that it is safe for the customers using it. Once a month an external company takes a sample from the pool, and this is tested in an accredited laboratory. These readings are taken according to the pool manual and are made available to the Health Authority. The pool filters are backwashed about two or three times a week according to the need. The discharged water is stored in holding tanks and then discharged at a later stage at emission point E5.

Parameter	Limit	Action	Time frame
pH	6-10	The pH of the pool water is monitored and recorded twice daily. This must be between 7.2 - 7.6. This value is ideal for optimum water quality and safety to pool users. Due to this the pH of the backwash cannot be out of the required limits	Implemented
		A pH reading of the backwash settling tanks will be taken and recorded to confirm that limits are not exceeded. Reading to be taken before the settling tanks are discharged.	October 24
Total residual chlorine	0.3mg/L	Pool backwash is performed before the dosing of chlorine, thus ensuring that the chlorine level is at its lowest value	Implemented
		Use of holding tanks so the backwash water is stored for a period to allow chlorine to dissipate naturally.	Implemented
		UV Treatment: Using UV light can break down chlorine compounds in water. Installing a UV system can help in reducing chlorine levels in backwash water.	To be implemented if limit values exceeded
Total suspended solids (TSS)	35mg/L	Use holding tanks to allow suspended solids to settle out of the water. The water can be left to sit in the tank for a period, allowing the solids to settle to the bottom.	Implemented
		Regular cleaning of settling tanks from settle solids, ideally once a month during the pool operating months.	October 24
Temperature	5°C above ambient	Use of settling tanks so that temperature will go room temperature. Since pool is not heated this occurrence is impossible to occur.	Implemented

ED7A: Brine Reject Waters

Fresh water for the aquarium tanks and first-class water for the complex is produced internally using a sea water reverse osmosis (referred to as RO). The RO is fed sea water from the same borehole as the chillers (used in E2) and by action of pressure and osmosis a good quality water is produced. This water is tested daily internally and once a month by an accredited laboratory. The health authority also monitors the water quality produced. As part of the RO process, about half of the water delivered to the RO is rejected as brine water. This brine water is discharged at E7.

Parameter	Limit	Action	Time frame
Temperature	5°C above ambient	The RO machine does not heat the water in any of its filtration processes, thus the rejected brine water is dependent on the input temperature. A future corrective action should the need arise would be to collect the rejected brine in a reservoir and leave it to cool down until the desired temperature is reached. Then it is discharged in E7.	To be implemented if limit values exceeded
		A daily temperature reading of the rejected brine will be taken and recorded to confirm that limits are not exceeded	October 24
pH	6-10	The RO machine is equipped with a pH meter that constantly monitors the value. If the value goes below pH 6.4 the machine is stopped automatically and immediately. This is of importance to the same RO machine so as not to damage the membranes. Since the input cannot go below 6.4, the rejected brine cannot go below these values.	Implemented
		A daily pH reading of the rejected brine will be taken and recorded to confirm that limits are not exceeded	October 24

End of report
