

CASE STUDY:

Oasis of the Seas

FT. LAUDERDALE, FLORIDA, USA

The CleanSea System is certified to MEPC 159(55) rules by



CleanSea[®] System Treats Wastewater Onboard the Largest Cruise Ship in the World

Background

The successful management of the world's marine environment has unique challenges when compared to land based environments. The oceans encompass a huge area to manage, their political boundaries are blurry, and conditions in one small area can have serious impacts on much larger, far removed areas.

With the acquisition of Hydroxyl Systems Inc. in 2009, Headworks BIO[™] Inc. expanded its wastewater treatment portfolio to include MBBR/IFAS biological wastewater treatment systems. The CleanSea advanced shipboard wastewater treatment system, from Headworks BIO Inc., has specifically been designed for the demands at sea and is currently installed on the largest cruise ship in the world, the Oasis of the Seas.

Oasis of the Seas is an oasis-class cruise ship in the fleet of Royal Caribbean International. The ship was completed and turned over to Royal Caribbean in November 2009. Oasis set a new record for carrying over 6,000 passengers. Since then, the Oasis class has expanded to include her sister ship, the Allure of the Seas. Both vessels cruise the Caribbean from Port Everglades in Fort Lauderdale, Florida.

Customer: Royal Caribbean International
Industry: Marine

KEY FACTS

- **Length:** 360 m (1,187 ft)
- **Width:** 65 m (208 ft)
- **Passengers & Crew:** ~8,400
- **Hydraulic Capacity:** 3,000 m³/day (0.79 MGD)
- **Typical Flow:** 2,000 m³/day (0.53 MGD)
- **Max. Influent BOD₅:** ~1,500 mg/L
- **Max. Influent TSS:** ~850 mg/L

Headworks BIO meets Alaska State Discharge Standards

- **Effluent BOD₅:** < 15 mg/L
- **Effluent TSS:** < 15 mg/L

Design

The CleanSea system onboard the Oasis of the Seas processes all of the ship's wastewater, including all black, grey, galley, and laundry water. Mixing of black and grey water streams is fully automated and is followed by primary solids removal by fine screen rotating drums. The screening equipment incorporates an automatic sparging system which ensures that the screen surface is maintained clean and free of solids build up. The solids removed at this stage, and at all later stages, are dewatered to produce powder-like solids that are fully burnable and can be incinerated on board or bagged for safe shore disposal.

At the core of the CleanSea system is the ActiveCell® MBBR/IFAS biological treatment process. The ActiveCell process employs thousands of virgin polyethylene media operating in a mixed motion within an aerated wastewater treatment basin. Every piece of media provides a protected surface area that supports the growth of heterotrophic and autotrophic bacteria. The high density of bacteria ensures a high rate of biodegradation and is also self-maintaining, requiring no chemical additives, cleaning, or backwashing.

Subsequently, ActiveFloat™ DAF equipment removes total suspended solids generated in the biological process and any particulate matter not removed during primary solids removal. Tertiary filtration then provides a positive barrier to particulate and total dissolved solids.

The final treatment stage is UV disinfection where high intensity, multiple stage UV reactors disinfect the effluent water as it flows through in a single pass. Non-biodegradable viruses, pathogens, and pharmaceutical residuals are destroyed. Disinfected effluent may then be directed to ballast holding tanks or overboard for discharge.

“ We've been extremely impressed by their [Headworks BIO] determination to not only accomplish certification of the system on time for the ship's maiden voyage, but to ensure that the system is the best possible design aboard any cruise liner in the world. On many levels, Oasis of the Seas is a world class engineering feat, including the unique biological system for treating its wastewater. ”

- Sami Hautala

Vice President of STX Europe

Results

The system exceeds all current effluent standards and was designed with a large capacity of 3,000 m³/day to cope with the requirements of 6,300 passengers and over 2,000 crew members. MBBR technology requires less energy and space than conventional or membrane wastewater treatment systems, both paramount considerations in the extremely limited confines of a cruise ship.

The CleanSea system is also certified to MEPC 159(55) rules by Det Norske Veritas. By performing this process onboard, the waters of the world do not have to process the wastewater generated by humans at sea allowing the Oasis of the Seas to greatly minimize its environmental impact wherever she may travel.



The CleanSea System installed on the ship's hull during ship building. The biological treatment basins are located in the far corner of the block.