

Seven Seas Mariner

2009 Alaska Season Progress Report/Source Reduction Evaluation

During Alaska 2009 season, *Seven Seas Mariner* complied with The Alaska Department of Environmental Conservation (ADEC) Large Commercial Passenger Vessel Wastewater Discharge Permit No. 2007DB0002 and received authorization, 2007DB002-0022, from ADEC to discharge at interim limits for: ammonia, copper and zinc, at concentrations in compliance with the interim limits.

This Progress Report/Source Reduction Evaluation (SRE) identifies opportunities to reduce the presence of ammonia, copper and zinc in the *Seven Seas Mariner's* wastewater discharges.

However, the *Seven Seas Mariner* will not sail in Alaska waters in 2010, nor is she scheduled to return in 2011. Therefore, the ship's wastewater discharge permit will simply expire and, at this time, we do not intend to apply for new authorization.

Advanced Wastewater Treatment System:

The *Seven Seas Mariner* is fitted with two Advanced Wastewater treatment system made by Hamworthy – Membrane Bio Reactors – Type MBR 240C – USCG Type II approved. Capacity max 180 m3 per day.

The MBR operates as an aerobic biological treatment system. Incoming waste is fed into a high strength biomass within which there is a diverse microbial ecology that breaks and consumes the raw sewage. The by-products of consumption are water and carbon dioxide; the water passes through the membrane and is discharged, the carbon dioxide is vented outside along with the air that is used for the aeration of the bio-mass.

The membrane module contains large numbers of ultra-filtration membrane tubes designed to achieve very high permeate production under the cross-flow scouring velocity.

The MBR 240C holds a Certificate of type approval – compliance with IMO MEPC.2 (VI) – and therefore vessel has a valid “Document of Compliance for International Sewage Pollution Prevention” issued by Bureau Veritas (Classification Society) on January 2007.

Evaporator Distillate Water:

Vessel is fitted with two fresh water generator made by Serck Como (Germany) – Type MSF 400 –S. Distillate capacity is 400 m3 per day, utilizing steam only or using jacket water only or by means of any combination of both heat sources.

Pipelines:

The vessel systems that deliver influent to the wastewater treatment system area as follow:

- Black water system: toilets/ urinals/hospital- drain, sink
- Grey water system: sink, drain and baths, showers of the cabins/ suite/ accommodations
- Grey water system: sinks and drains of the galleys
- Grey water system: Pulpers
- Grey water system, Laundry sinks and drains
- Grey water system: Jacuzzis

On board pipelines have been made of following materials:

- Grey water – stainless steel
- Sewage – stainless steel
- Potable water system: machinery spaces/ bunkering – galvanized steel/ distribution system – copper
- Technical water – galvanized steel and copper

Source Reduction Evaluation Overview:

Efforts under our plan will fall into one of two categories of activities, as a minimum:

1. Source Reduction of inflows to reduce introduction of constituents to the waste water stream
2. Technology Evaluation / Implementation to identify and install (*pending SS Mariner's return to Alaska trade*) technology to reduce effluent concentrations.

Influent Source Reduction Evaluation:

The following chemicals were used onboard during the Alaska 2009 season and eventually interfaced with the Hamworthy MBR wastewater treatment system.

Laundry Destainer, Stain Remover	5 GAL per Pail, = 1 x 5, # 15982
Laundry Detergent 1	5 GAL per Pail, = 1 x 5, # 15214
Laundry Encompass, Pre-Spotter	2.5 GAL per Pail, = 1 x 2.5, # 16055
Laundry Tri-Star Neutral NP	5 GAL per Pail, = 1 x 5, # 12083
Laundry Starch	35 LBS, = 1 x 35 Pound, # 18812
Stain Blaster "B"	24 OZ per Bottle, 4 BTL per CS, # 10327
Stain Blaster "G"	24 OZ per Bottle, 4 BTL per CS, # 10187
Stain Blaster "R"	24 OZ per Bottle, 4 BTL per CS, # 10188
Stain Blaster "S"	4 BTL per CS, # 16236
Stain Blaster "S"	4 BTL per CS, # 16236
Solid Brite	4 LB per Tub, 4 TUB per CS, # 16998
So Fresh Liquid Fabric Softener	5 GAL per Pail, Pail= 1 x 5 Gal US Pail, # 14310
Turbo Charge NP	5 GAL per Pail, = 1 x 5, # 15404
Ink Go	Ink Stain Remover, Case= 4 x 16 Each Bottle
Beverage Stain Remover "Bongo"	12 oz., Case= 24 x 1 Each Bottle
All Purpose Remover "Qwik Go"	12 oz., Case= 1 x 24 Each Each
Rust Stain Remover "Rust Buster"	Case= 12 x 1 Each Bottle
Tar Stain Remover "Tar Go"	Tar Stain Remover, Case= 4 x 1 Each Bottle
Yellow Go- Stain Remover	Stain Remover, Case= 4 x 1 Each Bottle
Eco-San Chlorine Sanitizer	Bottle
Mikro Quat	Gal US

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Cleaning Tablets WMF Coffee Machine	Tub
Cleaning Liquid WMF Milk Dispenser	Bottle
Mikro Bac III	Gal US
Liquid Hand Soap	Gal US
Oasis 115xp - Floor Cleaner	Pail
Oasis Pro 42 - Glass Cleaner	Bottle
Oasis Pro 14 - All Purpose Antibacterial Cleaner	Bottle
Revitalize MP Spotter	Bottle
Oasis Pro 67G Bathroom Cleaner 2/2L	Package
Oasis Pro 43G Glass 2/2L	Package
Mag Fusion 6-3Lb	Package
Solid Fusion 6-6.75Lb	Package
Silver Fusion 3-4Lb	Package
Crystal Fusion 2-2.5Lb	Capsule
Gamazyme Toilet Descaler	5 Kg.
Muriatic Acid 31.5% for Jacuzzis and Swimming Pool	4 Pails
Sodium Hypochlorite 15%	20 Pails
Metal Fusion 4-6.75Lb	Package

While using the chemicals listed above, the following represents the “would-be” exceedances for Seven Seas Mariner during 2009 AK season when compared to the long-term, 2010, limits:

<u>Result</u> <u>mg/L</u> <u>(Daily</u> <u>Max)</u>	<u>Long-term</u> <u>Limit mg/L</u>		
May 09	Copper, dis	5.5	3.1
	Nickel, dis	9.4	8.2
	Ammonia	29	2.9
June 09	Ammonia	8.3	2.9
July 09	Copper, dis	4.4	3.1
	Ammonia	7.8	2.9
August 09	Copper, dis	6.7	3.1
	Ammonia	6.7	2.9
Sept 09	Copper, dis	10	3.1
	Zinc, dis	110	81
	Ammonia	7.4	2.9

We decreased bunkering in ports, while waiting for the potable water analysis results for level of ammonia and/or heavy metals. The two fresh water generators on board produced 360 m3/ day each (average). The following additives were added to the potable water: Soda ash/ Acid/ Potable water stabilizer and chlorine.

Based upon analysis indicating the presence of copper in some fresh water bunkered in Alaskan ports, we would have increased production of onboard fresh water as an alternative, if the vessel would ever return to an Alaska itinerary.

The potable water tanks are internally coated with Jotun “epoxy tankguard 412” paint, which it is known to be a solvent free epoxy product.

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Alternative cleaning products:

Several products have been changed in all areas of the ship including technical & hotel, in order to compare analysis and indicators of presence of metal.

Adoption of operational practices to reduce pollutant:

Reducing ammonia by biological reduction, by means of increasing the wastewater retention on board and reduce the load on the MBR treatment as to maximize the wastewater treatment process of the unit have been implemented. This is possible due to the large capacity of ship's ballast tanks.

The current mixing ratio of sewage and grey water influent before it is treated in the wastewater treatment system is – average ratio 5/95, already optimized as to not affect the effluent quality.

The MBR units (x2) were operating at a maximum daily flow rate lesser than 180 m³ per day/ per unit. This is well below the Manufacturer's max capability of 240 m³ each unit. Ship's tank capacity is designed to have a ballast system that could be used to ballast the ship or to hold grey water or treated grey water, for a total capacity of 2,717 m³. The wastewater holding tanks are all coated with Jotun "Epoxy Tankguard 412" paint. The coating is known to be a solvent free epoxy product.

Reducing traces of metals can also be achieved by continuous monitoring of the corrosion status of on board pipe work. On board the ship the potable water piping system is made of galvanized steel for the bigger diameters in the machinery spaces and copper piping for deck distribution.

In order to minimize the piping corrosion and to control the softness a potable water stabilizer made by UNITOR is dosed in the piping system.

Piping monitoring is included in the vessel planned maintenance system, AMOS-W.

Substitution of non chemical methods for methods that involve chemicals:

If the *Seven Seas Mariner* should ever return to the Alaska trade then efforts would be made to identify potential sources of copper, zinc and ammonia as they may enter the waste water stream, and to investigate and implement means to reduce their presence in the influent to the Advanced Waste Water Purification Systems (AWWPS) on board. The major phases of this evaluation would be:

- Document influent to waste streams as potential sources:
 - i. Most significant cleaning or other chemicals in terms of volume and/or concentration of constituents
 - ii. Source water evaluation
 - iii. Other potential contributors
- Evaluation and estimation of potential contributions from cleaning products or source water to copper, zinc, ammonia in the effluent?
- Identification of potential product / source water substitution to reduce constituent concentrations or environmental loading.

Treatment Technology Evaluation:

Identification of potential treatment technologies for addressing the target constituents is both more complex than, and yet will be considerably informed by, the influent source reduction evaluation described above. Therefore during the forthcoming months we will work with our AWWPS vendors “Hamworthy” as to evaluate additional treatment technologies as may be appropriate for reduction of these pollutants that are practicable for implementation in a cruise ship environment. Hamworthy will assist us on the refining process of best operational practices on board.

Hamworthy has initiated studies with UK Water Research Centre as to ascertain that the G.P. Table 1 limits can be consistently met in wastewater applications by an environmentally sustainable means and Hamworthy will continue to investigate applicable and proven technologies to satisfy the regulatory requirements. As far as treatment of Technology Evaluation work research by Hamworthy, no data have been made available thus far.