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REVISION OF RESOLUTION MEPC.159(55)

Information and proposals of the Baltic Sea States submitted to MEPC on nutrient reduction technology and nutrient removal standards for sewage treatment plants

Submitted by Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, the Russian Federation and Sweden

SUMMARY

Executive summary: This document contains information and proposals of the Baltic Sea States submitted to MEPC 60 and MEPC 61 on nutrient reduction technology and nutrient (nitrogen and phosphorus) removal standards for sewage treatment plants. Some further refinements to the proposed new text for resolution MEPC.159(55) are also given.

Strategic direction: 7.1

High-level action: 7.1.2

Planned output: 7.1.2.1

Action to be taken: Paragraph 12

Related documents: MEPC 60/6/2, MEPC 60/22, MEPC 60/INF.4, MEPC 61/7, MEPC 61/24 and resolution MEPC.159(55)

Introduction

1 DE 54 noted information by the Secretariat on the outcome of MEPC 61, in particular that MEPC 61, when approving draft amendments to MARPOL Annex IV, recognized that the Revised guidelines on implementation of effluent standards and performance tests for sewage treatment plants (resolution MEPC.159(55)) would need updating in view of the new requirements and agreed to instruct the DE Sub-Committee to carry out this work. Consequently, MEPC 61 approved the inclusion of a new unplanned output in the Sub-Committee's biennial agenda and provisional agenda for DE 55 on "Revision of resolution MEPC.159(55)" with a target completion date of 2012 (MEPC 61/24, paragraph 7.36).

2 The purpose of this document is to provide to the DE Sub-Committee relevant information and proposals of the Baltic Sea States (Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, the Russian Federation and Sweden) submitted to MEPC 60 and

MEPC 61 on nutrient reduction technology and nutrient (nitrogen and phosphorus) removal standards for sewage treatment plants. Some further refinements to the proposed new text for resolution MEPC.159(55) are also given.

Revision of resolution MEPC.159(55)

3 At MEPC 61 the Committee approved draft amendments to MARPOL Annex IV with the aim of incorporating the concept of Special Areas and establishing a ban on the discharge of sewage from passenger ships within those areas, except when complying with new strict standards for nutrient concentration in the effluent of sewage treatment plants on ships.

4 In their submission MEPC 61/7, the Baltic Sea States made a proposal for a new MEPC resolution which would be otherwise identical to the existing resolution MEPC.159(55), but would contain requirements for reduction of nutrients from sewage and would apply to passenger ships only while sailing in Special Areas: "Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants for Passenger Ships Operating in Special Areas under MARPOL Annex IV", see annex 1.

5 The rationale behind this proposal was that, since the existing resolution MEPC.159(55) had only recently entered into force and manufacturers of sewage treatment plants had certified their plants according to this resolution, it might be preferable to have separate guidelines for the approval of sewage treatment plants for passenger ships. Otherwise the manufacturers might have to re-certify their plants, which have already been certified according to resolution MEPC.159(55) for ships other than passenger ships.

6 However, since MEPC 61 has instructed the Sub-Committee to revise resolution MEPC.159(55), the Sub-Committee is invited to consider the proposal to have two separate resolutions.

Proposals for nutrient removal standards

7 In their submission MEPC 61/7, the Baltic Sea States informed the Committee that the current onboard sewage treatment plants on the market are not specifically designed for nutrient removal. However, at least five companies (located in Finland, Germany, Norway and the United States) have indicated that the proposed discharge limits for nutrients are achievable and such equipment can be designed for marine use according to the proposed new guidelines. One company has informed that their equipment is already now able to meet the proposed reduction requirement for phosphorus and according to one company even a more stringent reduction requirement would be possible for total nitrogen. These companies design, manufacture and market environmentally friendly waste and wastewater collection and treatment solutions for the marine industry worldwide.

8 Based on this information, the Baltic Sea States proposed to MEPC 61 that the square brackets around the proposed nutrient removal standards in annex 1 could be deleted. The Baltic Sea States also propose that the underlined language given in annex 1 for section 4.1.6 should be replaced by the following text, because it better suits to the style of the language in the guidelines to the resolution and the other effluent standards in the guidelines are also based on the geometric mean values:

"6 Nitrogen and phosphorus removal standard

The geometric mean of the total nitrogen and phosphorus content of the samples of effluent (without dilution¹) taken during the test period shall not exceed:

- .1 total nitrogen²: 20 mg/l or at least 70% reduction³;
- .2 total phosphorus: 1.0 mg/l or at least 80% reduction⁴."

9 As a consequence of this proposal the underlined text to be added to the Form of the Certificate of Type Approval for Sewage Treatment Plants, after the text "(v) pH of the effluent is between 6 and 8.5." would read as follows (see section 3 of annex 1):

- "(vi) a geometric mean of total nitrogen of no more than 20 mg/l or at least 70% reduction; and
- a geometric mean of total phosphorus of no more than 1.0 mg/l or at least 80% reduction."

10 We have also noted that, due to the above amendments to the resolution, some amendments would have to be done to section 5.6.1 of the guidelines. In the third line of section 5.6.1 of new guidelines after the words "residual chlorine" it is recommended to add the words "total nitrogen and phosphorus" and in the last line to delete the words "total phosphorus".

Information on nutrient removal technology

11 Annex 2 provides technical information on nutrient reduction technology, which was given by the Baltic Sea States in section 7 of its submission MEPC 60/INF.4.

Action requested of the Sub-Committee

12 The Sub-Committee is invited to consider the proposals made in paragraphs 6 and 8 to 10 above and decide as appropriate.

¹ Influent containing grey water mixed with sewage is not considered dilution. Influent means the total flow into the sewage treatment process.

² Total nitrogen means the sum of total Kjeldahl nitrogen (organic and ammoniacal nitrogen) nitrate-nitrogen and nitrite-nitrogen.

³ Reduction in relation to the load of the influent.

⁴ Reduction in relation to the load of the influent.

ANNEX 1

(text as in annex 3 to document MEPC 61/7)

PROPOSED NEW MEPC RESOLUTION "GUIDELINES ON IMPLEMENTATION OF EFFLUENT STANDARDS AND PERFORMANCE TESTS FOR SEWAGE TREATMENT PLANTS FOR PASSENGER SHIPS OPERATING IN SPECIAL AREAS UNDER MARPOL ANNEX IV"

1 This annex proposes a new MEPC resolution, "Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants for Passenger Ships Operating in Special Areas under MARPOL Annex IV".

2 The new guidelines would only apply to passenger ships and would have the same text as resolution MEPC.159(55), "Revised Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants", except for the inclusion of the additional requirement of nutrient removal, as an effluent standard in section 4.1 of the guidelines (new text is shown underlined), as follows:

.6 Nutrient removal

The nutrient concentrations of the samples of effluent without dilution¹ should be:

.1 total nitrogen² [< 20 mg/l or at least 70% reduction³];

.2 total phosphorus [< 1.0 mg/l or at least 80% reduction⁴].

3 It is also proposed that the following text would be added to the Form of Certificate of Type Approval for Sewage Treatment Plants, after the text "(v) pH of the effluent is between 6 and 8.5.":

(vi) nutrient concentration of the effluent is less than [20 mg/l or at least 70%] for total nitrogen and less than [1.0 mg/l or at least 80%] for total phosphorus.

4 Finally, it is proposed that the new guidelines should enter into force at the same point of time as the new discharge regulations for new passenger ships, i.e. [1 January 2013].

1 Influent containing grey water mixed with sewage is not considered dilution. Influent means the total flow into the sewage treatment process.

2 Total nitrogen means the sum of total Kjeldahl nitrogen (organic and ammoniacal nitrogen) nitrate-nitrogen and nitrite-nitrogen.

3 Reduction in relation to the load of the influent.

4 Reduction in relation to the load of the influent.

ANNEX 2

(text as in annex 2, paragraphs 7.1 to 7.11 to document MEPC 60/INF.4)

7 INFORMATION ON A SEWAGE TREATMENT PLANT CAPABLE OF REDUCING DISCHARGES OF NITROGEN AND PHOSPHORUS

7.1 As an alternative to delivery of sewage ashore, sewage could be treated to remove phosphorus and nitrogen. Apparently, sewage treatment plants currently on the market are not specifically designed for this purpose. However, at least one company is able to offer such equipment. The company in question designs, manufactures and markets environmentally friendly waste and wastewater collection and treatment solutions for the marine industry worldwide.

7.2 Technical information provided by the company is given below. Although such treatment systems are not manufactured by all sewage treatment producers at the moment, demand would surely give rise to supply as well. The information is for a sewage treatment plant for a 3,300 person cruise vessel.

General presentation of the process

7.3 The process is a single stream advanced wastewater treatment system where all the waste streams are treated in one process (see schematic Figure 3). The process is based on effective equalizing and mixing of the incoming waste streams, pre-treatment by screens, an aerated biotank and a membrane bioreactor. In this proposal, a nutrient removal step is incorporated into the basic process.

7.4 The nutrient removal is accomplished by adding one anoxic tank for nitrogen removal and a dosing unit for phosphorus precipitation (see Figure 3) to the membrane bioreactor treatment unit (MBR) that includes a membrane tank with membrane modules.

7.5 Generally, biological nitrogen removal is not reversible and is carried out in two biological stages: aerobic nitrification of ammonia via hydroxylamine and nitrite to nitrate, and, subsequently, anoxic denitrification of nitrate via intermediate stages ($\text{NO}_3 \Rightarrow \text{NO}_2 \Rightarrow \text{NO} \Rightarrow \text{N}_2\text{O} \Rightarrow \text{N}_2$) to nitrogen gas. Normally, the rate limiting stage is nitrification. In the shown process, the nitrification takes place in the MBR process itself. The nitrogen will exit the treatment system in the anoxic tank as nitrogen gas. The anoxic tank is simply a non-aerated completely stirred tank that is normally around one third of volume of the main MBR process.

7.6 The removal of phosphorus from wastewater involves the incorporation of phosphate into biomass solids on the main treatment process and subsequent removal of those solids. Phosphorus can be incorporated into the solids either by biological activity or by chemical precipitation. The most commonly used method, and also the method used in the shown process, is a chemical precipitation, where phosphorus is precipitated by adding metal salts or polymers. The solids and also the precipitated phosphorus are removed from the purified water by final membrane filtration.

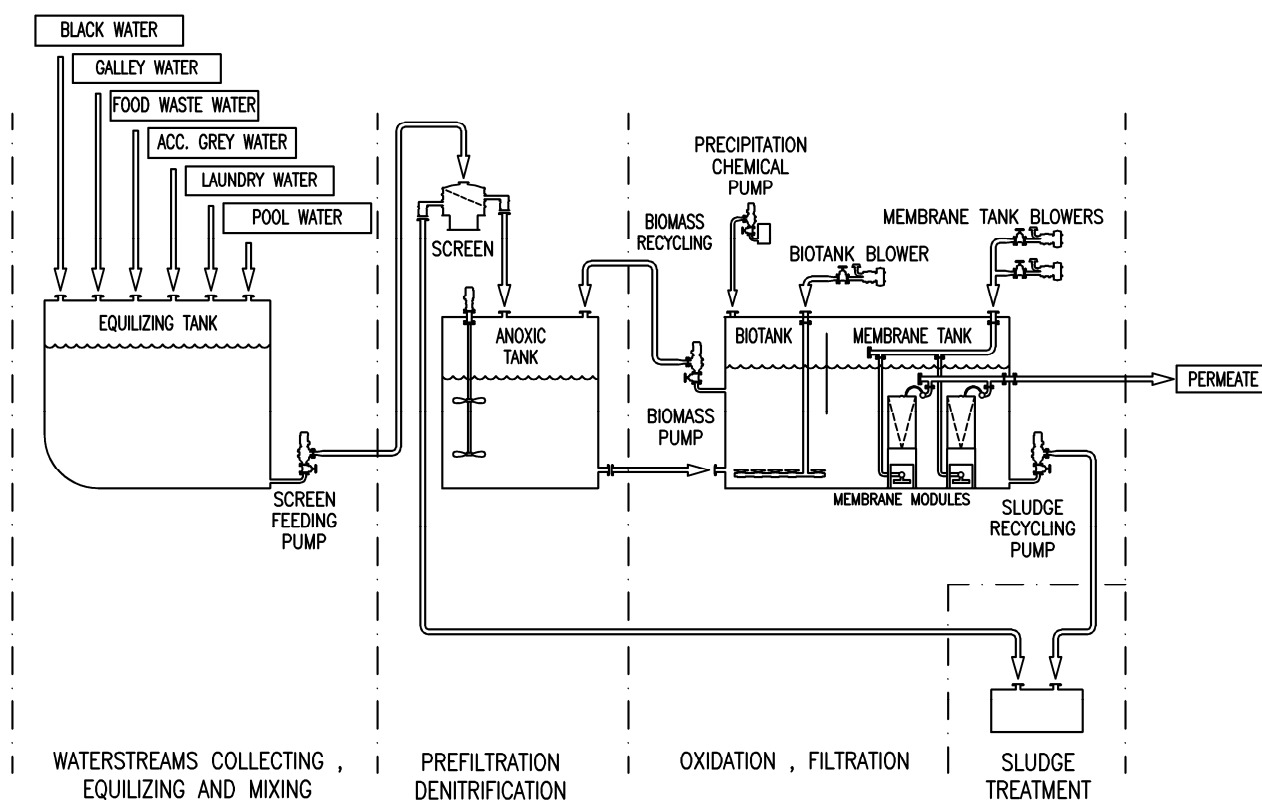


Figure 3. Schematic diagram of an advanced shipboard wastewater treatment plant utilizing a combination of biological removal of organics, nitrogen removal, coprecipitation of phosphorus and membrane filtration

7.7 The process is fully automated and controlled through a programmable controller of the plant by vacuum/pressure switches, level switches, DO, TSS and pH sensors, flow meters and foam detectors. Additional measurement of the final effluent quality, e.g., turbidity, ammonia and nitrate, can be included into the system, if requested.

Description of design data and performance for an advanced waste-water purification system for a cruise ships with 3,300 passengers and crew members

7.8 The process is designed by using the company's knowledge on wastewater concentrations that is based on several shipboard samplings and studies. The calculation also contains approximately 30% "built-in" redundancy for the different wastewater characteristics between different ships and wastewater fluctuations. It should also be noted that a typical wastewater amount per person on a cruise ship is 250 litres/person/day (calculation made on requested 185 litres/person/day).

7.9 The process is calculated for the following hydraulic loading:

- Black water: 3,300 people * 15 litres/day = 49.5 m³/day
- Galley: 3,300 people * 32 litres/day = 105.6 m³/day
- Food waste: 3,300 people * 3 litres/day = 9.9 m³/day
- Accommodation grey water 3,300 people * 110 litres = 363 m³/day
- Laundry water 3,300 people * 25 litres = 82.5 m³/day.

The total daily nominal flow is 610.5 m³/day.

7.10 The expected effluent biological oxygen demand (BOD) and TSS values are below 10 mg/l. Onboard tests show that the membrane process effluent is fulfilling all current limits.

Table 3. Various sewage treatment standards for ships

	IMO MARPOL	IMO MARPOL	USCG	Alaska	Navy NIAG	Rhein River	WWTP
	MEPC. 2(VI)	MEPC. 159(55)	33CFR 159 PT1-300	33DFR 159.309	2015		Test results
BOD ₅ (Biochemical oxygen demand) mg/l	50	25		30	15	25	< 3
TSS (Total suspended solids) mg/l	50	35	150	30	50		< 5
COD (Chemical oxygen demand) mg/l		125				125	< 50
Faecal/Thermotolerant coliform cfu/100 ml	250	100	200	20	100		BDL
Residual Chlorine mg/l				10	0		0
pH		6-8.5		6-9			Within limits

7.11 The design values for nutrient concentrations in the effluent are:

Nitrogen: < 10 mg/l
Phosphorus: < 0.5 mg/l.