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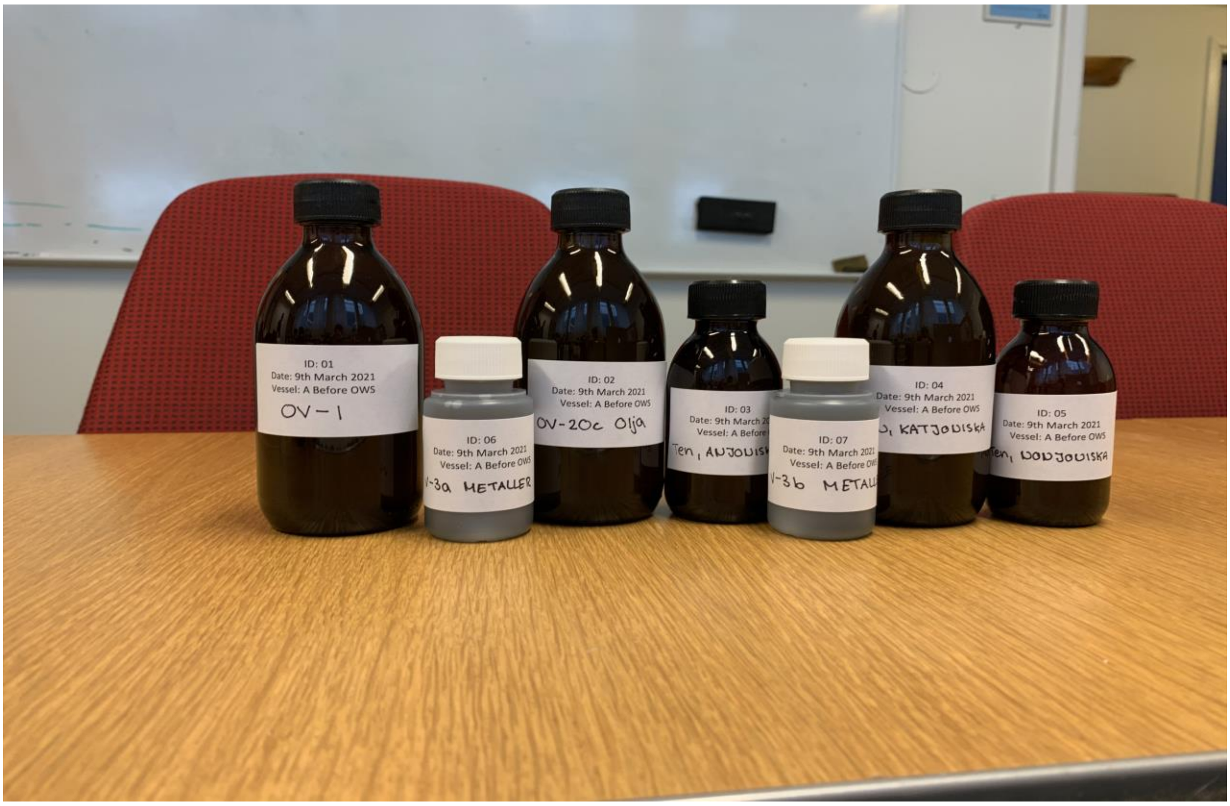

Chemical pollutants released in treated bilge water

Bachelor thesis for Marine Engineering Program

MATTIAS ISAKSSON
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DEPARTMENT OF MECHANICS AND MARITIME SCIENCES

CHALMERS UNIVERSITY OF TECHNOLOGY,
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Cover:
Sample bottles of Vessel A before OWS that were sent to ALS

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PREFACE

The interest in the bilge water was aroused when a company had a presentation about their bilge water separator. We discussed the possibility on performing a bachelor thesis with them about the chemical compounds in treated bilge water. We received the answer that there was almost nonresidue in treated bilge water. This answer sparked an idea to test their theory and to see if separators produced that type of result. During our research we found very little information about the environmental impact that bilge water has, and when talking with other teachers, the actual knowledge about bilge water were limited. We have now found that there are chemical compounds in bilge water, that can affect the marine environment in a negative way. The authors who write this bachelor thesis are studying at Chalmers University of Technology, Marine Engineer 180 HEP. This thesis gives a general result of the concentration of discharged bilge water. Above all else, we would like to thank Ida-Maja Hassellöv with all the guidance and support. We want to say thank to all the crews onboard the vessels who took their time into taking the sample and answering the questionnaire. We would also say thank to the offices of the Swedish ship owner, who helped with the coordination of distributing the samples. Thanks to our sponsor, Stiftelsen Sveriges Sjömanshus and last but not least we would also like to thank everyone that had constructive criticism about the text.

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SAMMANDRAG (in Swedish)

Länsvatten är en komplex cocktail av färsk- och havsvatten och av olika organiska och oorganiska föreningar. Varje fartyg producerar mellan 50 och 7500 liter per dag. Utsläpp av länsvatten regleras av IMO och förordningen fokuserar på att begränsa oljedropparna i länsvattnet under 15 PPM. Nya undersökningar av sammansättningen av behandlat länsvatten antyder att det innehåller mer skadliga ämnen än bara oljedroppar. Speciellt olika metaller i koncentrationer över gränsvärdena. Prover av länsvatten har samlats in och undersökts från sex fartyg i den svenska handelsflottan, dessa prover hämtas från två provtagningspunkter från varje fartyg. Detta för att kunna utvärdera och jämföra länsvattenproverna före och efter det som har behandlats med en oljevattenavskiljare. Resultaten för behandlat länsvatten, zink är 124 gånger över gränsvärdet, nickel är 34 gånger över. Detta visar att metaller finns i länsvattnet efter behandling och att metaller ligger över gränsvärdet när det släpps ut i havet. Mängder ytaktiva ämnen släpps också ut i havet med länsvattnet, men dessa ämnen saknar regleringsvärden. På grund av covid-19 togs prover av ingenjörerna ombord och samlades inte av samma ingenjörer varje gång. Denna avhandling visar bara resultaten för sex kärl och deras separatorer använder alla den kemiska metoden för att behandla länsvattnet.

Nyckelord: Behandlat länsvatten, kemiska föreningar, metallrester, marina miljöer, länsvatten, länsvattenseparator

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ABSTRACT

Bilge water is a complex cocktail of fresh- and seawater and of different organic and inorganic compounds. Each vessel produces between 50 to 7500 liters per day. Release of bilge water is regulated by IMO and the regulation is focusing on limiting the oil droplets in the bilge water below 15 PPM. New investigations into the composition of treated bilge water suggests that it contains more harmful substance's then just oil droplets. Especially different metals in concentrations above limit values. Samples of bilge water have been collected and investigated from six vessels in the Swedish merchant fleet, these samples are retrieved from two sampling points from each vessel. This, to be able to evaluate and compare the bilge water samples before and after that have been treated by an oil water separator. The results for treated bilge water, zinc is above the limit value by 124 times, nickel is 34 times over. This shows that metals exist in the bilge water, after treatment, and metals are above the limit value when it is released into the ocean. Quantities of surfactants are also released into the ocean with the bilge water, but these substances lack regulatory values. Because of the covid-19 pandemic samples were taken by the engineers onboard and not collected by the same engineers every time. This thesis only shows the results for six vessels and their separators all use the chemical method to treat the bilge water.

Keywords Treated bilge water, chemical composition, metal residues, marine, environment, bilge water, OWS, oily water separator, SDS, surfactants

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ACRONYMS AND TERMINOLOGY

AA-EQS	Annual Average - environmental quality standards
Administration	If not other specified in the text this means Flag state
Black water	Any waste from toilets and urinals
Grey water	Wastewater from showers, laundry, washing
HFO	Heavy fuel oil
LNG	Liquefied natural gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MDO	Marine diesel oil
MPC	Maximum Permissible Concentration
OWS	Oily water separator
PAH	Polyciclic Aromatic Hydrocarbons
PEC	Predicted Environmental Concentration
PNEC	Predicted No Effect Concentration
Pollution	Any pollution that are introduced into the sea, harm humans, living resources and marine life.
PPM	Parts per million
SDS	Sodium dodecyl sulphate
Separation equipment	In this report separation equipment is such equipment that are capable of treat bilge water to a minimum 15 ppm oil content
Whitebox	An oil content monitor unit

1. INTRODUCTION

Questions regarding environmental pollution are taking a larger place on the political stage. Citizens are putting pressure on governments to reduce the footprint on the planet (United Nations, 2015). The Swedish government are taken steps onward to terms with pollution at sea. In the recent released report from the Swedish Cross-Party Committee on Environmental Objectives (2020), the government of Sweden are pointing out that there is a need for a new marine environment law.

Marine pollution from ships is a consequence of the maritime transportation. According to Mearns et al. (2020), more than 86 000 ships are sailing the ocean, not including fishing and naval vessels. Maritime transportation is portrayed as having a less emission per ton-km compared to other means of transportations (Cristea et al., 2013). In order to reduce vessel's environmental impact IMO have done several regulations, more recent a new law on sulphur content in the fuel. The sulphur content in the fuel should not exceed 0,5%, this is in order to reduce the air emissions from vessels (MARPOL, 1983). According to Ytreberg et al., (2020) it is estimated the vessels in the Baltic sea releases 5,5 million m^3 of gray water unregulated, the gray water have high concentration of zinc and copper, another water that is released in the oceans is bilge water. The lowest point in the ship is called bilge, here all the drainage accumulates, the accumulated water is called bilge water (Coca et al., 2011). Bilge water is a mixture of sea water, fresh water, gasoil, oils, cleaning agents, metals and chemicals. The bilge water comes from leakage, maintenance or spill. To maintain the vessel stability it is important to discharge the bilge water (Magnusson et al., 2018). A study done by Det Norske Veritas (2010) showed that vessels produce between 50 L to 7 500 L of bilge water per day (Aalbu et al., 2010). The amount is depending on what type of cargo, size of the vessel, and size of the engine. For example, passenger's vessels produce more bilge water than any other vessel. The study also showed that 66% of vessels discharging of bilge water into the sea, 17 % is pumping ashore. The other 17 % is using both methods. Although International Convention for the Prevention of pollution from ships, (MARPOL) (1983) regulates the oil content, this does not mean that the oily water separator (OWS) systems are removing all chemical substances before discharge. The concentration is depending various factors such as cleaning detergent, fuel, engine model and routines of the crew. Since there are many different chemicals used onboard, the bilge water gets difficult to treat and many treatment techniques are often optimized solely to achieve a low oil content. The bilge water gets treated through an OWS, the by-product is sludge. Sludge is a rich mixture of oil residues and chemical composition. The sludge accumulates in a special tank, a separate dirty oil tank, when full pumps to a shore-based treatment facility. To be allowed to discharge treated bilge, the oil content must not exceed 15 parts per million (ppm). MARPOL Annex 1, chapter 3, regulation 15, determines when, where and how oil or an oily mixture can be discharged (MARPOL, 1983).

To comply with the regulation, several manufacturers of OWS-systems has a control unit to monitor the oil content. The unit can be designed differently with functions like position log, oil content, time, and date. All this to prevent illegal discharge. In the control unit, there is an oil content monitor unit and a three-way valve. The oil content monitor unit measures the oil content, and a three-way valve directs the oily water ether back to the tank or into the sea. In resolution A.393(X) (IMO, 1992), there are guidelines and specifications for the separator unit and the measuring unit.

According to MARPOL (1983) there is no requirement, when releasing bilge water or about the distance to shore but the ship must proceed a route. These rules are focusing on the prevention of oil pollution from bilgewater, the content of bilge water is more complex than just oil droplets. The result from Tiselius & Magnusson (2017), shows that there is a cocktail of metals, organics and sodium dodecyl sulphate (SDS) substances left in the bilgewater after the OWS. These substances are released into oceans and seas all over the world without regulations or restriction. Recent investigations, show that treated bilge water still can be harmful to living organisms (Tiselius & Magnusson, 2017). Bilgewater that have passed through the OWS still contains SDS, found in cleaning agents. Nilvea Ramalho Oliveira (2020), shows that SDS has significant effects on reproduction and growth of marine nematodes.

1.1 Background

MARPOL (1983) regulates how, where and when pollution can be discharged from ships. Annex I is focusing on liquid waste streams made by oil, and this Annex, contains regulation about bilge water. Regulation 15, focusing on the bilge water, the oil content in the bilge water should not exceed 15 ppm without any dilution. The OWS-manufacturer designs the sensors in such a way, so it is responding to oil. Since the regulation do not regulate other hazardous substances, this is released into the sea unregulated, unless the OWS collects substances other than it was designed for. To clarify and come to terms with the lack of information regarding bilge water and its consequences, more samples and analyzes needs to be performed on ships on a larger scale.

New scientific research proving the content of chemical compound in treated bilge water would put pressure on IMO to change the regulatory framework surrounding the bilge water. Organizations like IMO sorted under UN are enforcing new legislation on pollution from ships through MARPOL, an international convention.

1.2 Aim of the study

The aim of this study is to examine bilge water before and after the OWS to assess the treatment efficiency of different types of pollutants such as organic substances, metals and surfactants. The focus of the analyses is detection of metal content, as this is yet not regulated prior to discharge of treated bilge water.

1.3 Research questions

- Can metals be detected in treated bilge water after OWS?
- How well are the OWS reducing the amounts of surfactants in bilge water?
- Can it be established that bilge water from older ships is dirtier than newer ships?
- What proof is there that coal filter produces cleaner bilge water?

1.4 Delimitations

The report is concentrating on Swedish shipping companies due to the geographical operation and to save expenses for transporting samples. Since the Covid-19 pandemic, the sample bottles are sent to the vessel, with an instruction on how to take the samples. The samples are collected and repacked before being sent to ALS. Difference sampling points before OWS is used since the vessels have a different basic configuration of tanks, some vessels are capable of heating the bilge water before getting treated. A questionnaire regarding information on the vessel was following the sample bottles. This questionnaire could have been larger and included more on the tasks performed prior to recovering the samples. At Chalmers University of Technology, the bilge water samples are dividing into smaller sample bottles. ALS is requiring that samples are in small sample bottles, to make their work easier and the samples are not sent to the same location. This could lead to pollution of the samples and not proper mixing of the samples could lead to a misreading, since the bilge water is not a homogeneous mixture. The result is anonymous as agreed with the shipping companies.

2. THEORY

A vessel is constructed by many complex systems that are working together for the vessel to function properly. In this theory the report will go through the systems regarding bilgewater *Figure 1*, restrictions and different methods for treating bilge water. How it occurs and why it is important to understand the system producing bilge water to understand its significant. Bilge water is accumulated in ether bilge wells or a sludge tank. Bilge water is then pumped over to a bilge water separator tank. The separator tank has heating to speed the up the separation process. The oily water mixture goes through the bilge water separator unit, the bilge water that have a concentration of oil over 15 ppm goes back to the bilge water separator tank, the treated water under 15 ppm goes overboard.

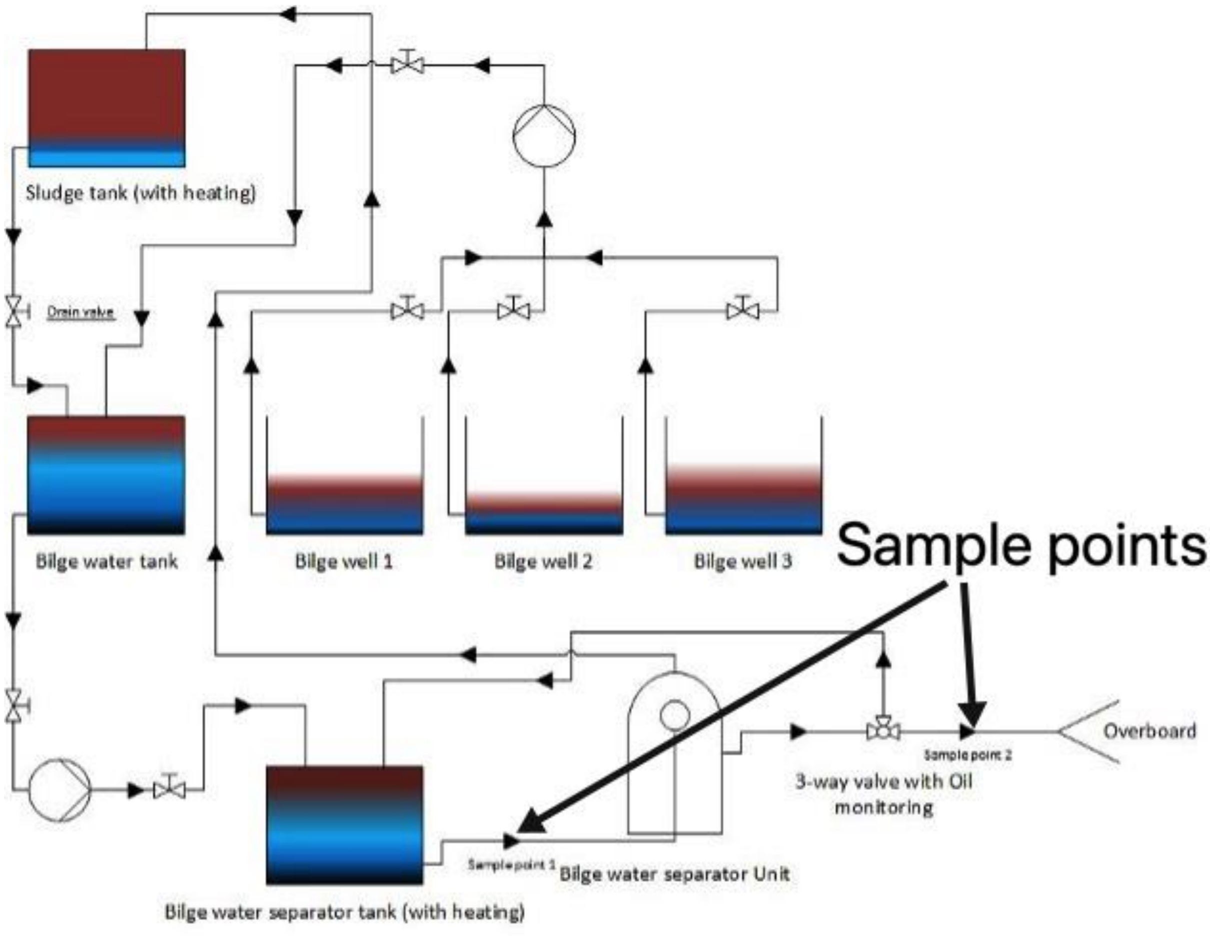

Figure 1. Schematic diagram of an example for bilge water system. The brown color represent oil, blue is water and black is soot or other bigger particles. The sample points are where the crews have been instructed to take.

2.1 Machinery space and configuration of bilge water system

A ship is like a small city and contains many different installations. For personnel to live and work at a vessel some functions are required. The vessel needs to produce electricity for lights, cooking, heating and machinery to work. Produce and store fresh water for drinking, showering and cleaning, a sewage system that can take care of grey and black water produced onboard the vessel. Main engine to produce forward thrust. Emergency engine in case of blackouts. Auxiliary engines are used to provide electricity when the main engine is not running or during a startup operation. There are different types and sizes of pumps, cranes and electrical motors for different application. Machinery space differs in size and levels depending on what type of merchant ship. Vessel's machinery consumes a combination of different oil, chemicals and cleaning detergents. Most of this is consumed by the machinery but some of the products are spilled or because of leakage are collected in the bilge wells.

2.1.1 Combustion engine

The internal combustion engine is the basic foundation for transportation at sea (Kees Kuiken, 2008). There are three types of engines on a vessel, main engine, auxiliary engine and emergency engine. The main engines primarily purpose is to provide power for the propelling of the ship and are also capable of generating electricity. Auxiliary engines are only used for the purpose of generating electricity. The main engines traditionally run-on heavy fuel oil (HFO) or marine diesel oil (MDO). New sources of fuel are being investigate and implemented such as liquified natural gas (LNG), sewer gas, biogas (Kees Kuiken, 2008). When the main engine runs on heavy fuel oil and the sulphur content is over 0,5 %, then the use of a scrubber is mandatory. A scrubber is an exhaust gas cleaning technique that is used in order to lower the sulphur content in the exhaust. The scrubber can be running in two different moods, closed- or open-loop. When open loop is using sea water to essentially wash the exhaust. After this process, the sea water is returning to the sea with a high acid content. The pH is 3 and is a mixture of sea water and sulphuric acid, with metals and organic substances (Ytreberg et al., 2019). The auxiliary engine can run on the same fuel as the main engine. Emergency engine is only used in case of starting from dead ship or when a blackout happens. The engine is smaller than the main and aux engine and usually runs on diesel.

2.1.2 Fuel system

The fuel line system used for engines can be different sizes (Kees Kuiken, 2008). For a vessel in the merchant fleet the transportation of fuel is of utmost importance. Fuel is received by a bunkering process to a storage tank. The tank should protect the fuel from being contaminated and there should be ways of draining of condense. To protect the engine from wear and tear, fuel is “cleaned” by passing through a separator and is also complemented with filters, before reaching the booster system that supply the engine with fuel (Kees Kuiken, 2008).

2.1.3 Lubrication-oil system

The lubrication system is a crucial part of the engine. The main focus for lubricating-oil is to reduce the friction between the moving parts of the engine, like piston rings, cylinder liners, bearings and valve steams (Kees Kuiken, 2008). Its secondary purpose is to protect surfaces from corrosion, keep the sealant between different parts like piston rings and cylinder and also used to cool down heated parts and transfer the heat to the high temperature (HT) water.

2.1.4 Water cooling systems

Water cooling systems are an integrated part in the engine room. Seawater brings endless supply of cooling medium, but because of the high mineral content its section is design to be as short as possible (Kees Kuiken, 2008). The seawater transfers heat from the fresh water via plate coolers out into the sea. Fresh water is treated water in order to reduce the possibility for organic growth and contains softening to reduce the damage to surface of piping and other material. A freshwater system is a closed-loop system divided into low temperature (LT) and high temperature (HT). The HT-water transfers heat from parts like the main engine that can reach temperatures between 1500° to 2000° C (Kees Kuiken, 2008). The LT water cools down the HT water and transfers that heat to the seawater.

2.1.5 Stern tube

The stern tube is fitted in the hull of the ship and is used to seal the propeller. The stern tube is connected to a gravitation tank which must be at least 3 meters above sea level (Kees Kuiken, 2008). This system is to prevent seawater from penetrating the ship and also to lubricate the moving parts. The stern tub is drained during dockings and are controlled for water content regularly (Kees Kuiken, 2008).

2.1.6 Boilers

Marine boilers are closed systems that is used to heat up water into steam or to recirculate heated water (Puskar John R, 2017). A burner is used for the purpose of heating of fresh water into steam. The steam is circulated through piping's in the ship to heat up various installations like different tanks and living spaces.

2.1.7 Sludge tank

The sludge tank accumulates oily residue from filters and separators. The sludge tank is connected with a separator that can be for lubrication-oil, fuel-oil or bilge water (Kees Kuiken, 2008). The sludge is heated up in order to decrease the separation time it takes to separate water from the oil, the oily water is then drained to the bilge water tank.

2.2 Regulations and Restriction

Annex I (Marpol, 1983) is the focus for the report since it is containing pollution by oil. The definition for bilge water according to MARPOL (1983) is any liquid that have enter the bilge wells, bilge piping, tank top or bilge holding tanks is bilge water. This means even clean water that are not contaminated by oil should be treated as such.

In Chapter 3, Regulation 14, it is stated that there is a need for oil filtering equipment if ship gross tonnage is above 400 gross tonnage. The oil filtering equipment design shall be approved by the Administration and ensures that the oil content not exceeding 15 ppm. Ships larger than 10 000 gross tonnage is obligated to have an oil filtering equipment. It should be designed in such a way that so it is fitted with alarm when the limit of 15 ppm cannot be maintained, if oil content is above 15 ppm it should automatically stop the discharge (MARPOL, 1983).

2.2.1 Oil Record Book

Every tanker above 150 gross tonnage and vessels above 400 gross tonnage are according to MARPOL (1983) obligated to have an oil record book part I (Machinery space Operation). In this record book following operations should be noted:

I. ballasting or cleaning of fuel oil tanks,
II. discharge of dirty ballast or cleaning water from oil fuel tanks,
III. collection and disposal of oil residues (sludge),
IV. discharge overboard or disposals otherwise of bilge water which has accumulated in machinery spaces,
V. bunkering of fuel or bulk lubricating oil.

Since bilge water is considered to contain oil residues, the bilge water tanks should be monitored every week. The record in the oil record book part I should contain the identity of the tank, capacity of the tank, amount of liquid and the amount of bilge water have been manually drained from other storage tanks. According to IV when bilge water is discharged this should be noted in the oil record book part I, the quantity, when and where. The oil record book part I should also contain if the oil filtering equipment have failed and what caused it to fail (MARPOL, 1983).

2.2.2 Oily-water Separating Equipment

To have a standard method of what an oily water separation unit should be capable of, there is a resolution called A.393(X) (IMO, 1992). The resolution consists of four parts:

I. General
II. Specification for oily-water separating and filtering equipment
III. Specification for oil content meters
IV. Method for the determination of oil content

In the second paragraph of the preamble in the resolution are defining the difference between the two terms separating equipment and filtering equipment. Separating equipment should be capable of treat the bilge water or ballast water to decrease the oil content to 100 ppm. Filtering equipment is the term used to describe equipment that are capable of reducing the oil content in bilge water or ballast water to a maximum of 15 ppm. In this thesis the term separating unit have the same specification as filtering equipment.

In order to get type approval by IMO, in Part II. the technical specification it states that separating unit should be design in such way, so it is suitable for shipboard use. The unit should also be capable and expected not to be affected by movements and vibrations. It should be reliable even with angles up to 22.5 degrees. However, the feed can be changing from oil to water or from water to oil, and this should not affect the oil content meter so that discharge overboard is not over 15 ppm. The test specification is stating that least two types of oil should be used during the test, an oil with high density and a fuel oil with lower density. The test water should be heated to the manufacturers design and should be able to maintain that temperature during the whole test period. This test is using different starting states, the unit filled with oil or filled with water. A test should last minimum of three hours, to make sure that it is operate continuously and automatically. During the test, samples are taken, similar to this thesis's sample points (IMO, 1992).

2.3 Different types of oily water separator

There are several methods for treating bilge water. Bilge water is a rich mix of oil, chemicals, and heavy metals. The bilge system consists of wells, tanks, pipes, heating elements, separator unit, filter unit, and oil content monitor, *Figure 1*. The sludge tank is a storage tank for dirty oil and water from the separation of the fuel. When draining the sedimentation tank, oil particles follow to the bilge water tank. The main storage tank accumulates all bilge water before pumping it to the separator unit. Some vessels use a bilge water settling tank, where the bilge water is settling before treatment, to help the settling process, the tank is heated. The heat improves the settling process up to 80% (Fang & Lai, 1995). According to A. Amran & N. Mustapha (2020), there are six different techniques to treat bilge water, gravitational, centrifugal, flotation, chemical, filtration, and biological. The separator unit can use gravitational force, chemical, physio-chemical, biological treatment or in a combination of two or more. In IMO's (2021) list there are 583 approved bilge separators.

2.3.1 Gravitational method

The use of Stoke's law separates the oil droplets from the water. The gravitational method is the most common method for cleaning oil from water (Coca et al., 2011). The efficiency depends on many factors. The primary factor in getting a good result is linear flow. The laminar flow lets the droplet settle on top of the water before the skimmer is skimming off the surface, as seen in Figure 2. This type of separation avoids turbulent flow using plates to let the water flow in a linear way. The plates open up for clogging, and the need for maintenance is a significant drawback (Coca et al., 2011).

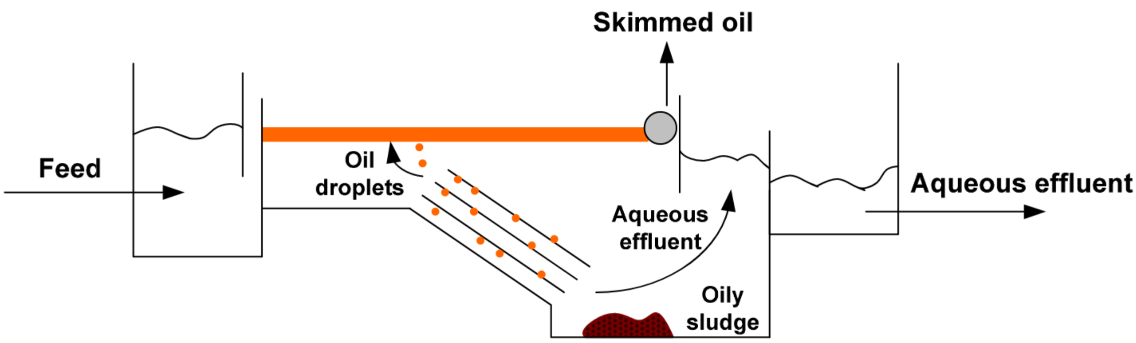

Figure 2. Schematic diagram of API separator.
Source (COCA J., GUTIÉRREZ G., BENITO J.)(2011) TREATMENT OF OILY WASTEWATER. Used with permission 19-02-2021

2.3.2 Centrifugal method

Centrifugal separator uses the density differences of oil droplets and water. By spinning a disc-stack very fast, the separator uses the centrifugal force. As seen in Figure 3 the heavier particles such as water sling out from the center and the disk stack. The oil creeps up along the disc-stack and exits at the top of the stack. The cleaned water is then passed on to the oil content sensor and discharged into the sea (Coca et al., 2011).

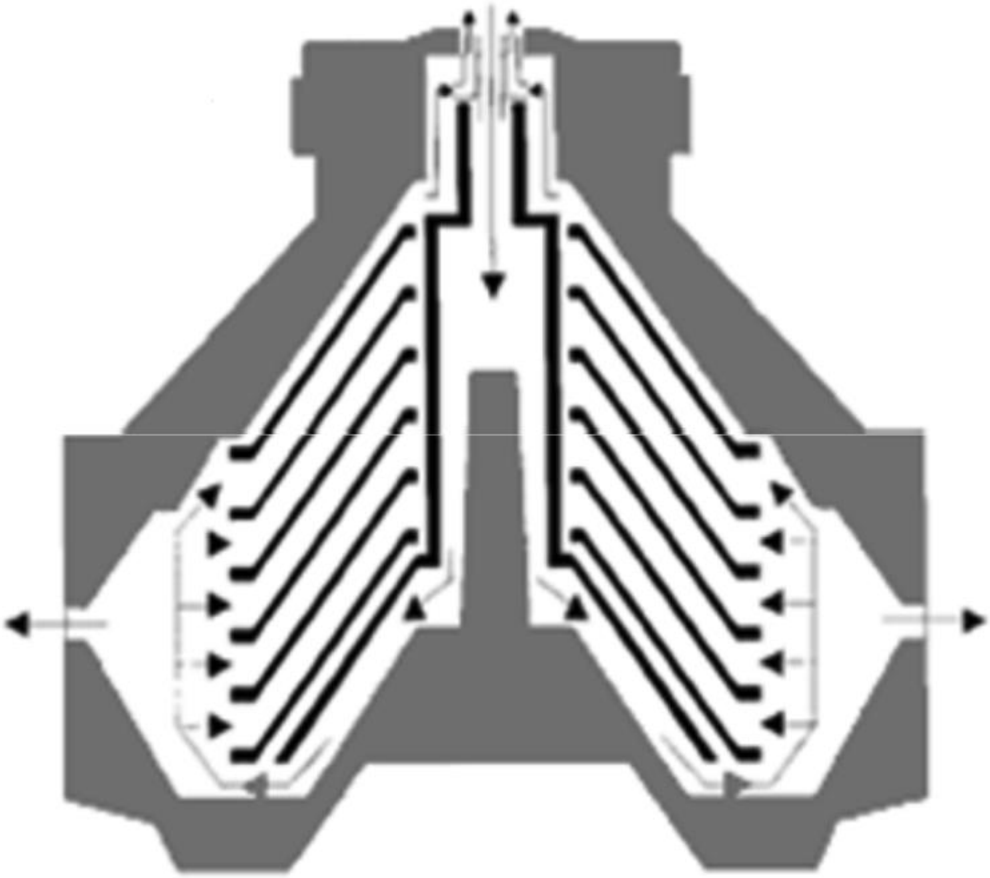

Figure 3. Schematic diagram of centrifugal method. *Source COCA J., GUTIÉRREZ G., BENITO J. (2011) TREATMENT OF OILY WASTEWATER. Used with permission 19-02-21*

2.3.3 Flotation method

This method uses the same principle as a gravitational method, letting gravity pull the heavier water particles to the bottom, mixing compressed air help the settling process. The small air bubbles stick to the oil particles and bring them up to the surface. The system looks similar to the gravitational method as seen in *Figure 4*. The compressed air lets the settling process to speed up, and it is less sensitive for turbulent flow. The air bubbles creates a foam, the foam are then skimmed off by the skimmer and then discarded to the dirty oil tank (Coca et al., 2011).

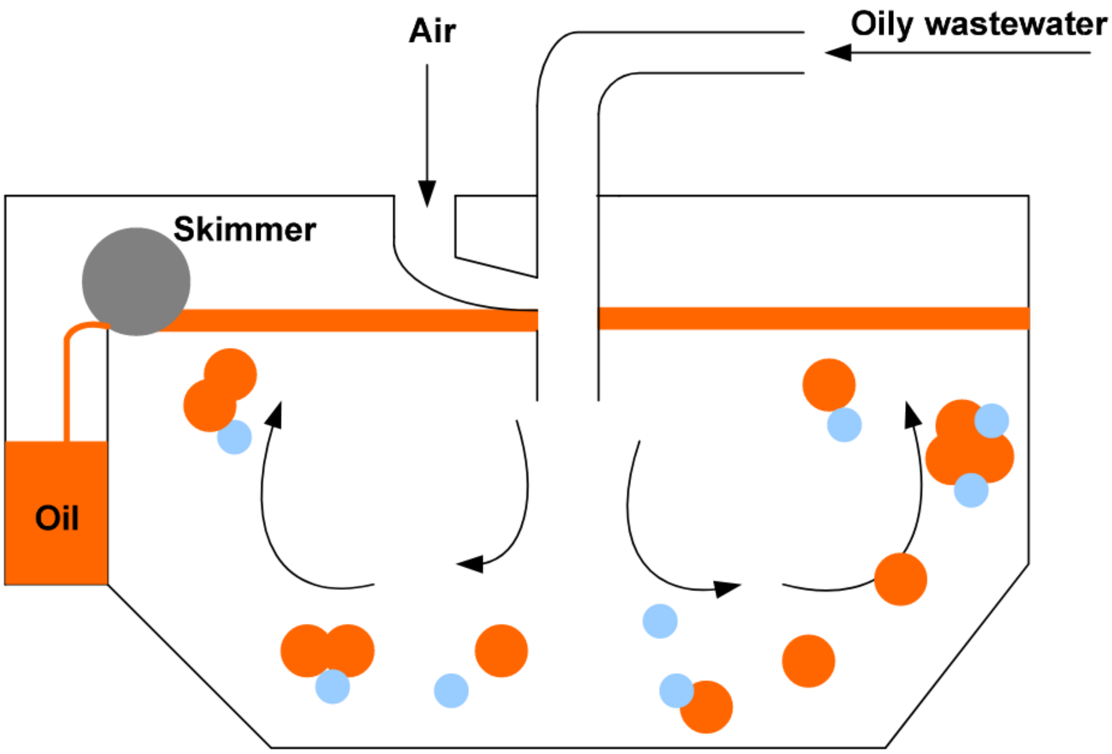

Figure 4. Schematic diagram of an IAF unit. *Source COCA J., GUTIÉRREZ G., BENITO J. (2011) TREATMENT OF OILY WASTEWATER. Used with permission 19-02-2021*

2.3.4 Chemical method

There are three different methods using chemicals, coagulation, flocculation, or in a combination. The oil droplets have a charge on the surface of each particle. The charge makes the particles repel each other. The chemicals reduce the charge and make the oil droplets clump together, which makes the extraction easier. This method is in need for using another method to help with extraction for example flotation or gravitational method.

2.3.5 Membrane distillation/filtration method

According to Coca et al., (2011), this method is using passive components. By using a delicate membrane, letting the fluid separate itself into large and small particles. The membrane can be made of two different material organic or inorganic. The organic is made of polymers, and inorganic is made of glass, ceramic or metals.

2.3.6 Biological method

The biological method is using microorganisms to eliminate or reduce the organic substances. The microorganisms break down the compound into simple end products through oxidation. According to (Aini Amran & Nor Adibah Mustapha, 2020), this is called a bioreactor. There are two principles to use the biological method, suspended- or attach-growth.

2.4 Oil content monitoring

Before the first oil content monitoring unit was developed, the use of sight glass was the main solution. This inspection glass let the viewer visually observe oil content and had to manually shutdown the separator. The regulations have been updated stepwise according to the technological progress, at first 200 ppm was the limit (1983), shortly after it was updated to 100 ppm and the present limit is 15 ppm. This was not that accurate due to the sight glass accumulated a lot of oil and poor lighting. The development of new methods was important in order to meet the 15 ppm requirement. The two most dominating method for oil detection is scattered light and fluorescence (Seebacher et al., 2018).

2.4.1 Scattered light

Scattered light method is using two photocells, one for comparing and one for reading, a powerful light and a comparator circuit. The light luminesces to both of the photocells. One of the photocells is at the other side of the bilge water pipe. The light shines through the water and to the photocell, the oil droplets scatters the light and the photocell reads the scattered light. The other photocell is the control photocell. The comparator circuit compare the control photocell and the other photocell and determine the oil content by using a database programmed to the comparator (Seebacher et al., 2018).

2.4.2 Fluorescence light

This method use the ability of substances to reflect UV-light in different wavelength. When a UV-light is shined upon an oil droplet it reflect UV-light back, by be able to read the wavelength it can be determined the concentration and what kind of oil (Malkov & Lowe, 2019).This method include expensive equipment compared to scattered light, but gives a more accurate reading of organic substances.

2.5 Bilgewater chemical composition

The contaminants of bilge water can be divided into three different groups. The rules and regulation of oil spill can be found in MARPOL, briefly described in 2.2 restriction and regulation.

2.5.1 Organic compounds

PAH are organic compound that has been classified as priority pollutions. There are 16 PAHs that has been singled out by United States Environmental Protection Agency as important (Kumar, B 2014) and they have become the standard for testing and are used by Swedish Environmental Protection Agency (2017). They are toxic to all living organisms and some of them are cancerogenic (Nilsson, 2020).

2.5.2 Surfactants

SDS is an anionic tensioactive surfactant (Nilvea Ramalho Oliveira, 2020) and is used in cleansing detergents. Cleaning detergents are used frequently onboard the vessel. The amount used on a monthly basis are between 25 to 150 litres, depending on size of the vessel. A study performed by Nilvea Ramalho Oliveira (2020) compares the response from two different marine nematodes after being exposed to SDS. The result shows that there is harmful effects on reproduction and grout for both species, except for the adult individuals that did not seem to be affected. SDS can be harmful to organisms under different stages in their development.

2.5.3 Metals

The metal composition of bilge water is complex, there is a substantial amount of different metals in the bilge water. There are some reports on metal pollution from bilgewater on particles for example Tiselius & Magnusson, (2017). The scientist was examining the concentration of bilge water released to the sea in short- and long-term perspective. The results revealed that metals in short-term perspective will stay closer to the surface and be absorbed by particles. The long-term perspective shows that the metals will gravitate to the seafloor and settle in the sediment.

In order to accurate determine elemental concentrations in bilge water, a digestion method is used. The digestion method uses acid and heat to break down the particles to the element content. By using this method, it gives a total amount of metals, the metals that are mixed in with the bilge water directly and the metals that are in particles. The method is also referred to as aqua regia, there are different method of aqua regia but the basic idea is mixing medium with acid and apply heat (Chen & Ma, 2001).

There is an increased awareness that risk assessment of chemical mixtures is essential Rudén, C. (2019), yet ecotoxicological studies of contaminants in the marine environment usually include one contaminant at the time, one type of organism at the time.
For some of the metals, environmental quality standards, or limit values in term of Predicted No Effect Concentration (PNEC, see section 2.5.4) are available (Table 1), but for many metals this information is still lacking. Bilge water is a cocktail of different types of contaminants such as metals, PAH and SDS.

2.5.4 PEC and PNEC

Predicted Environmental Concentration (PEC) and Predicted No Effect Concentration (PNEC) are used to evaluate toxicity of different substances in water. Where PEC being the environmental concentration of a substance and the PNEC is the limit for when a concentration of a substance can be harmful for the environment. This limit values, *Table 1*, are used to compare the concentration of metals and PAH in bilge water for the different vessels. The PEC / PNEC value for the different substances are in concentrated form and will be diluted when it enters the sea. The concentrated bilge water will mix with the sea and are therefore not realistic to use for this thesis, the absolute assessment is to use PEC/PNEC.. The other way of comparing is by using Maximum Permissible Addition (MPA), Maximum Permissible Concentration (MPC) or (MPA+Environmental Concentration). MPC can be the same amount as PNEC but could also be smaller if local governments can motivate the reason why.

Table 1

The PNEC value used in this thesis.

	Concentration (µg/L)
Substance	
Fluoranthene	0.0063[2]
Copper	1.45[3]
Zinc	1.1[3]
Chromium	3.4[3]
Pyrene	0.023[1]
Nickel	8.6[2]
Phenanthrene	1.1[1]
Lead	1.3[2]
Arsenic	0.55[3]
Chrysene	0.007[1]
Naphthalene	2.0[1,2]
Vanadium	2.5[4]
Fluorine	1.5[1]
Acenaphthylene	0.13[1]
Acenaphthene	0.38[1]

[1] Verbruggen E.M.J (2012)
[2] ENVIRONMENTAL QUALITY STANDARDS (2013)
[3] HVMFS (2013:19)
[4] European chemical agency (2020)

3. METHOD

This bachelor thesis is based on a quantitative research. The bilge water samples are from different vessels analyzed for the containment of organic compounds, SDS and metals. Information is gathered together with the samples that are taken onboard the vessels. Questionnaire, international legislation, schoolbooks and earlier written reports on the subject. Searching for documents were conducted through Google Scholar, Chalmers library's database and books. Most frequently used search-words were marine pollution, bilge water pollution, OWS.

3.1 Samples

Swedish ship owners were contacted with an introduction, Appendix A. The positive answer frequency was around 10 % of the contacted companies. The number of ships participating in the study from each company was decided, and the time frame were established. Samples were then collected by going to each ship to take the sample in same manner every time, to reduce the delimitation of the sample. Because of the covid-19 pandemic, this plan had to be changed. The sample bottles were sent out in order for the crew to take the samples.

3.1.1 Sampling procedure

Each vessel received bottles in order to be filled up before the separator and after, Figure 1. The work instruction, Appendix B, composed to provide the engineers with information on how to perform the sampling. The work instruction also made sure to establish the same sampling procedure for each vessel so that the sampling can be compared with each other. Each vessel was presented with a questionnaire, Appendix C, regarding the machinery space and the chemicals used onboard. Before the samples were sent to ALS, the samples were transferred to other bottles and marked for their individual analyze.

3.1.2 Requiring samples

A normal routine is to drain the stern tub ones a week to control the water concentration in the oil and to refill the tank. If samples are taken with this oil in the tanks it will show a higher oil index value. Samples after the OWS, can show a different value depending on the state of the OWS, some OWS needs to heat up in order to work properly. The main source of SDS is coming from cleaning agents. The agents are used constantly over time and the amount per month are registered but SDS are used sporadically in the machinery compartment and differs from day to day. The diversity of metals shown in the test result may have a different source from which they came. Some contamination such as aluminium can come from the cracking procedure when producing fuel and the paint used on the machinery walls can be lead based. Other activities that could generate metal concentrations could be welding, lathes, grinding and machines like a generator that contains copper. This works in combination to create that individual mixture in the bilge water.

3.1.3 Vessel information

Three vessel used diesel as fuel, two used ULSFO (ultra-low sulphur fuel oil), one used HFO and one used MGO. Only two vessel used CIP as a cleaning method when cleaning the separators, one vessel is pouring back the CIP detergent and send it ashore to a special facility. The vessels are using around 80 L of cleaning detergent per month and the most popular brand is UNITOR, with four out of seven users. The other detergent brand is Marisol and Indukraft. Six out of seven of the marine engineers believes that heavy metals goes through the OWS and one had no answer. Six out of seven uses some type of coal filter. The amount of bilge water each vessel release is by using this formula: $y = 0{,}1313x + 373{,}42$ (Tiselius & Magnusson, 2017), where y is the amount of bilge water accumulated each day and x is main engine power. By using this formula, the vessels are estimated to have an average 3286 L of produced bilge water per day.

Table 2

Vessel Information, the numbers are approximate in order to not reveal the vessels identification.

	Length o.a. (m)	Main engine power (kW)	Fuel, main engine	OWS manufacturer	OWS model	Amount of detergents (L/month)	Approx. bilge water produced per day (L)
Vessel A	160-210	20000-25000	ULSFO	Wärstilä senitec	OWS 1000	70	3000-3600
Vessel B	160-210	20000-25000	ULSFO	Wärtsilä senitec	OWS 1000	50	3000-3600
Vessel C	100-120	20000-25000	Diesel	Marinfloc	CD2.0	60	3000-3600
Vessel D	140-160	30000-35000	Diesel	Marinfloc	CD2.0	150	4300-5000
Vessel E	100-120	20000-25000	Diesel	Marinfloc	CD2.0	60	3000-3600
Vessel F	230-250	25000-30000	HFO	Wärtislä senitec	M25	150	3600-4300
Vessel G	140-160	5000-8000	MGO	Marinfloc	TD3-100	25	1000-1400

The results on each vessel from ALS were compared to vessels in the same category and other categories of vessels. On reviewing the result, there were no clear connection between the type of vessel and the chemical compound concentration in the bilge water. The decision to not divide them into different group in the results were made.

3.2 Bilge water chemical analyses

The company performing the chemical analyses was ALS. There are pre-defined test packages that ALS performs on samples to indicate different substances within the groups of organic compounds, SDS and metals.

3.2.1 Organic compounds

The analysis of organic compounds contains of two separated tests.
Test package 1 “OV-1 PAH (EPA-PAH, 16 st) I vatten”.
It targets PAH 16, (Swedish Environmental Protection Agency 2017) that consist of:
Naphthalene, Acenaphthylene, Acenaphthene, Chrysene, Fluorene, Phenanthrene, Anthracene, Florante, Pyrenees, Bens (a) anthracene, Benz (b) fluorants, Benz (k) fluorants, Benz (a) pyrene,
Dibens (a, h) anthracene, Benz (g, h, i) perylene 0.106 and Indeno (1,2,3, cd) pyrene.
Secondly it is the aromatic and aliphatic compounds, test package 2 “OV-20c OLJA GC-FID in water”.
Fraction C10 – C12, C12 – C16, C16 – C35 and C35 – C40.

3.2.2 SDS

The surfactants are in the nonorganic group and three different tests are performed by ALS. Test package 3 “surfactants, anionic”, test package 4 “surfactants, cationic” and test package 5 “surfactants, non-ionic”.

3.2.3 Metals

For metals, ALS analyzes the bilge water for 19 different metals with and without digestions. Test package 6 “ V-3a Metals (19) in polluted water after digestion” and test package 7 V-3b Metals (19) in polluted water after digestion”. The result contains the following metals: aluminum, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, quicksilver, sodium, vanadium and zinc.

4. RESULTS

The result from the analyzed bilge water is here divided into three different groups, PAH, SDS and metals. The vessels are presented in graphs (A, B, C, E, F and G) and the result is presented in µg/L. The mean composition of chemicals compound in bilge water per vessel before the OWS are surfactants 55.9 %, metals 43 % and PAH 0,6 %. The mean composition of chemical compound in bilge water per vessel after the OWS are metals 57.6%, surfactants 42.2 %, and PAH 0.2 %. The total amount of chemical compositions per vessel before the OWS are 10090 µg/L. The total amount of chemical compositions per vessel after the OWS are 7460 µg/L. The overall reduction of chemical compound in the bilge water is 26 %. The mean organic compounds per vessel are reduced from 63 µg/L to 14 µg/L. The mean surfactants concentration per vessel are reduced from 5642 µg/L to 3150 µg/L. The mean metal concentration per vessel is reduced from 4386 µg/L to 4300 µg/L, *Figure 5* and *Figure 6*. There are seven vessels participating in the study. Six of them are being used and one of them, vessel D, is being disclaimed. Vessel D is considered to be an outlier.

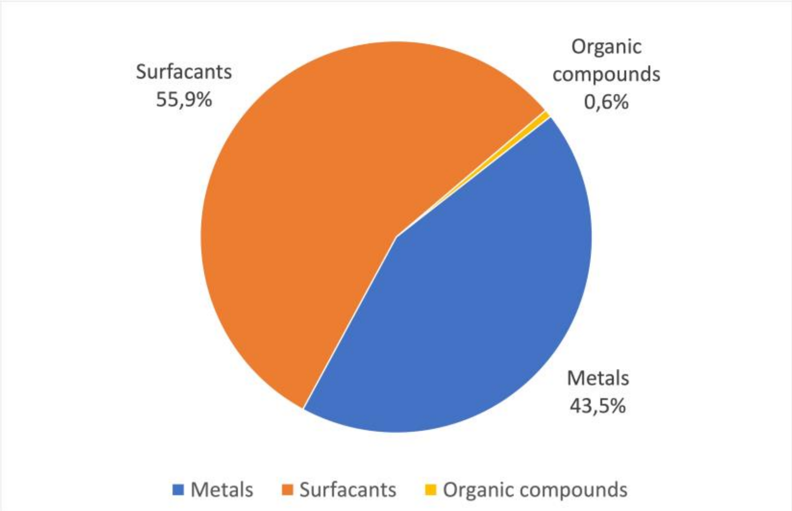

Figure 5. The result of the samples taken before OWS, mean value of all the metals, surfactants and organic compounds in µg/L. The sum of the mean value, surfactants: 5642 µg/L, metals: 4386 µg/L and organic compounds: 63 µg/L.

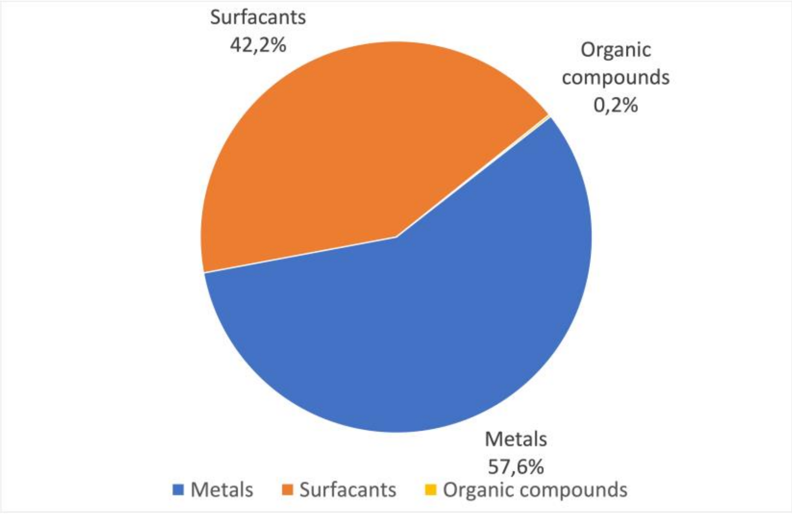

Figure 6. The result of the samples taken after OWS mean value of all the metals, surfactants and organic compounds in µg/L. The sum of the mean value, surfactants: 3150 µg/L, metals: 4300 µg/L, organic compounds: 14 µg/L.

4.1 Result of organic compounds, PAH

The mean value of organic compound for each vessel is 14 μg/L or 0.2% of the total chemical compound of bilge water after the OWS. The PAH is reduced by 78%. There is a diversity of results regarding the different PAHs. There are those PAHs that are below the PNEC value for each vessel like Phenanthrene and Fluorine. There are those that are above the PNEC value for some of the vessels. Fluoranthene are above the PNEC value for vessel A and B. For the other vessels the result for fluoranthene cannot be established, except that it is lower than 0.1 μg/L. Naphthalene is above the PNEC value for vessel A and C and the other vessels were below reporting limits. Chrysene has a PNEC value of 0.007 μg/L and the result from ALS can only indicate a result less then 0.01 μg/L for all six vessels, *Table 3*.

Table 3

Sampling result of after OWS and the limit value. The value that are red is over limit.

	Vessel A	Vessel B	Vessel C	Vessel E	Vessel F	Vessel G
Fluoranthene	0,01 ±0,0003	0,01 ±0,0003	<0,01	<0,01	<0,01	<0,01
Limit value	0,0063	0,0063	0,0063	0,0063	0,0063	0,0063
Pyrene	0,047 ±0,014	0,032 ±0,009	0,011 ±0,003	<0,01	<0,01	<0,01
Limit value	0,023	0,023	0,023	0,023	0,023	0,023
Phenanthrene	0,433 ±0,13	0,078 ±0,023	0,049 ±0,015	<0,01	<0,01	<0,01
Limit value	1,1	1,1	1,1	1,1	1,1	1,1
Chrysene	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
Limit value	0,007	0,007	0,007	0,007	0,007	0,007
Naphthalene	6,63 ±1,99	0,0691 ±0,207	9,85 ±2,95	<0,03	<0,03	<0,03
Limit value	2,0	2,0	2,0	2,0	2,0	2,0
Fluorine	0,701 ±0,21	0,106 ±0,032	0,367 ±0,11	<0,01	<0,01	<0,01
Limit value	1,5	1,5	1,5	1,5	1,5	1,5
Acenaphthylene	0,087 ±0,026	0,022 ±0,006	0,035 ±0,01	<0,01	<0,01	<0,01
Limit value	0,13	0,13	0,13	0,13	0,13	0,13
Acenaphthene	0,035 ±0,01	0,046 ±0,014	0,413 ±0,011	0,04 ±0	0,06 ±0	<0,01
Limit value	0,38	0,38	0,38	0,38	0,38	0,38

4.2 Result of Sodium dodecyl sulphate (SDS)

The mean value of SDS concentration in the bilge water for each vessel is 3150 μg/L. It stands for 42.2% of the chemical compound of bilge water after the OWS. The SDS is reduced by 45%. The concentration of cationic surfactants shows that the amount of cationic surfactants decreases in vessel A, E, F and G, increases in vessel C and are not affected in vessels B, *Figure 7.* The result from anionic surfactants shows that the amount of anionic surfactants are reduced after the OWS for all the six vessels, *Figure 8.*
The result from non-ionic surfactants shows that the amount of non-ionic surfactants are reduced in vessel B, C, E, F and G, and increased in vessels A, *Figure 9.*

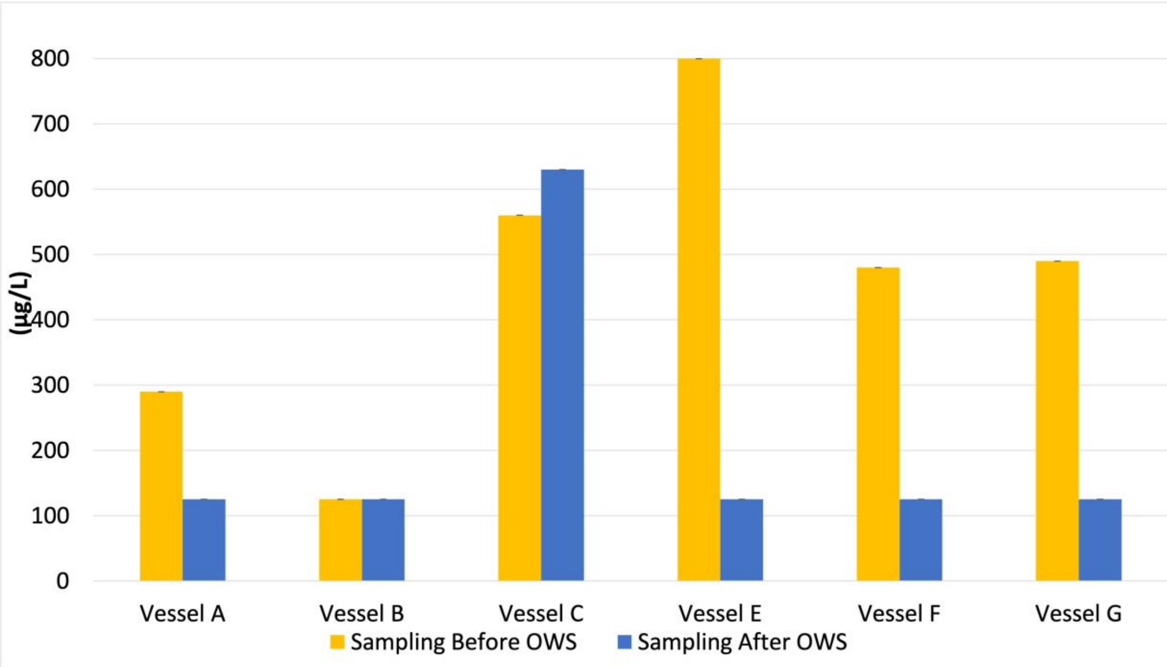

Figure 7. Sampling result of cationic surfactants before and after OWS. The error bars show measurement uncertainty according to ALS. Vessel D before: 5410 μg/L, after: 125 μg/L

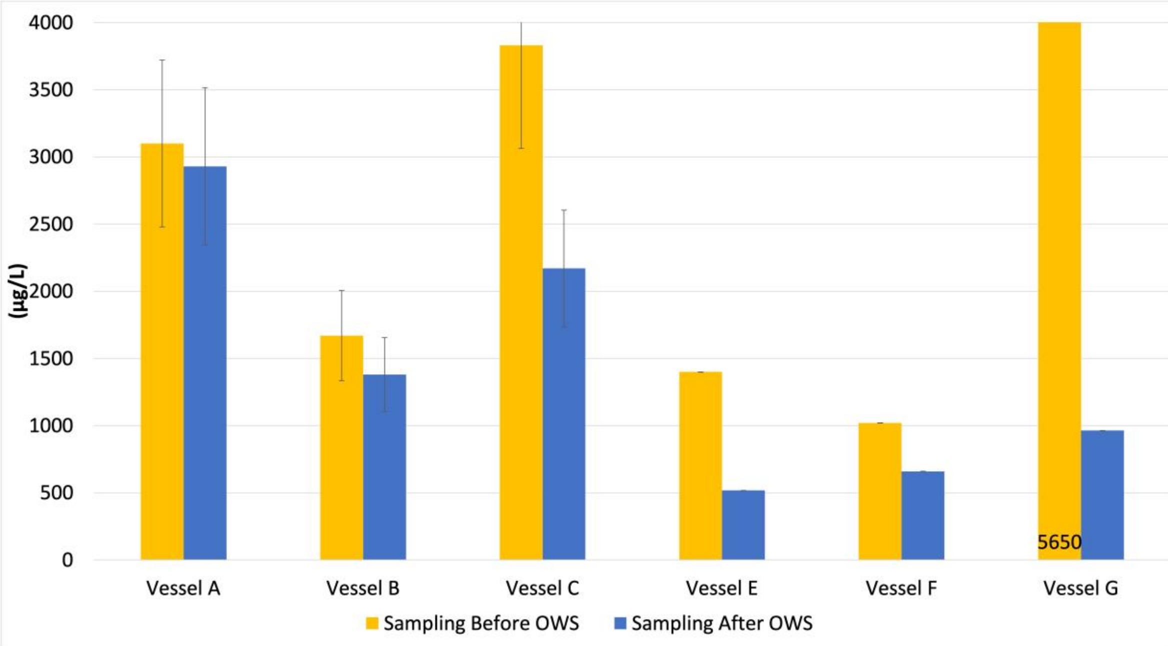

Figure 8. Sampling result of anionic surfactants before and after OWS. The error bars show measurement uncertainty according to ALS. Vessel D before: 8100 µg/L, after: 3070 µg/L

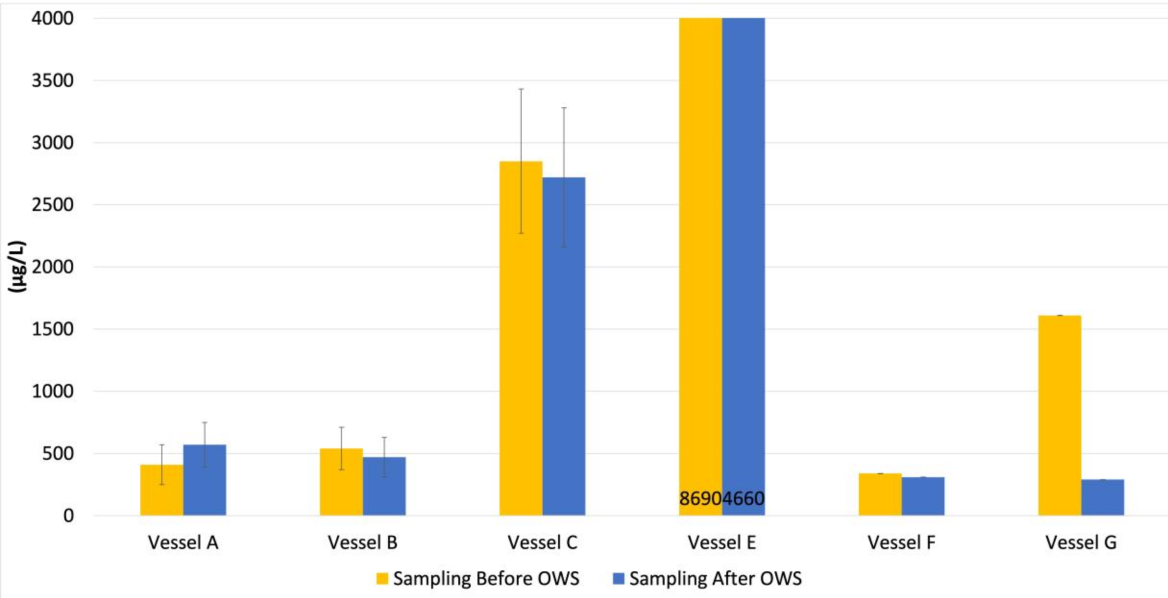

Figure 9. Sampling result of non-ionic surfactants before and after OWS. The error bars show measurement uncertainty according to ALS. Vessel D before: 500 µg/L, after: 100 µg/L

4.3 Metals

The mean value of metal concentration in the bilge water for each vessel is 4300 µg/L. It stands for 57.6 % of the mean chemical compound of bilge water after the OWS for each vessel. The metal amount in the bilge water is reduced by the OWS with 24%. Among the samples without digestion, corresponding to a dissolved fraction, there is one metal that stands for 53% of the metal concentration, aluminum, *Figure 10*. The mean value with digestion has six metals that stand for 97.2% of the metal concentration, aluminum 39%, manganese 33%, nickel 13%, zinc 5.9%, barium 3% and copper 2.4%, *Figure 11*.

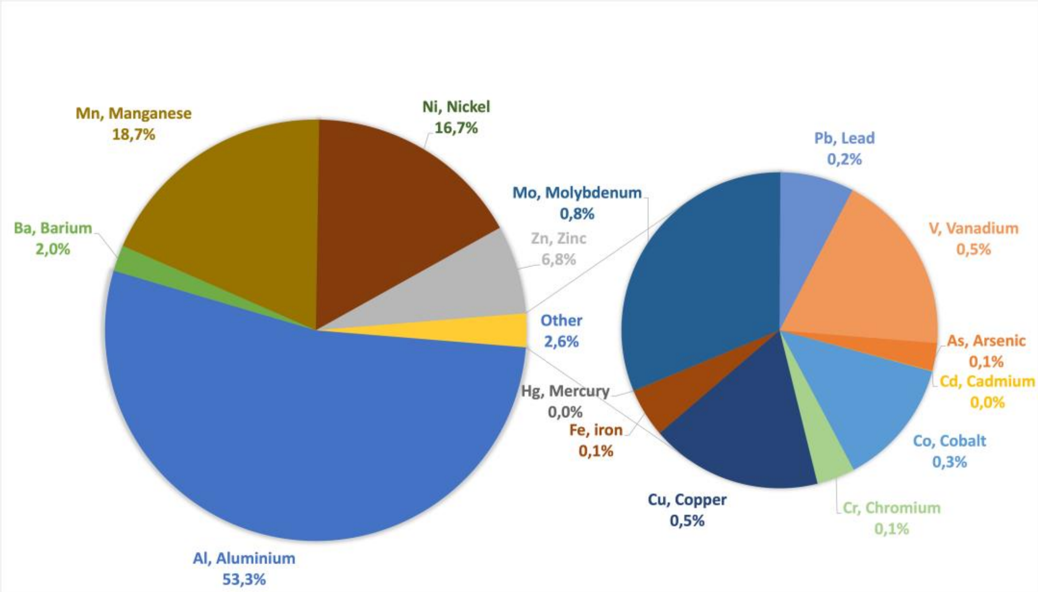

Figure 10. Sampling result of all metals after OWS without digestion, each metal is a mean value of all the vessel samples.

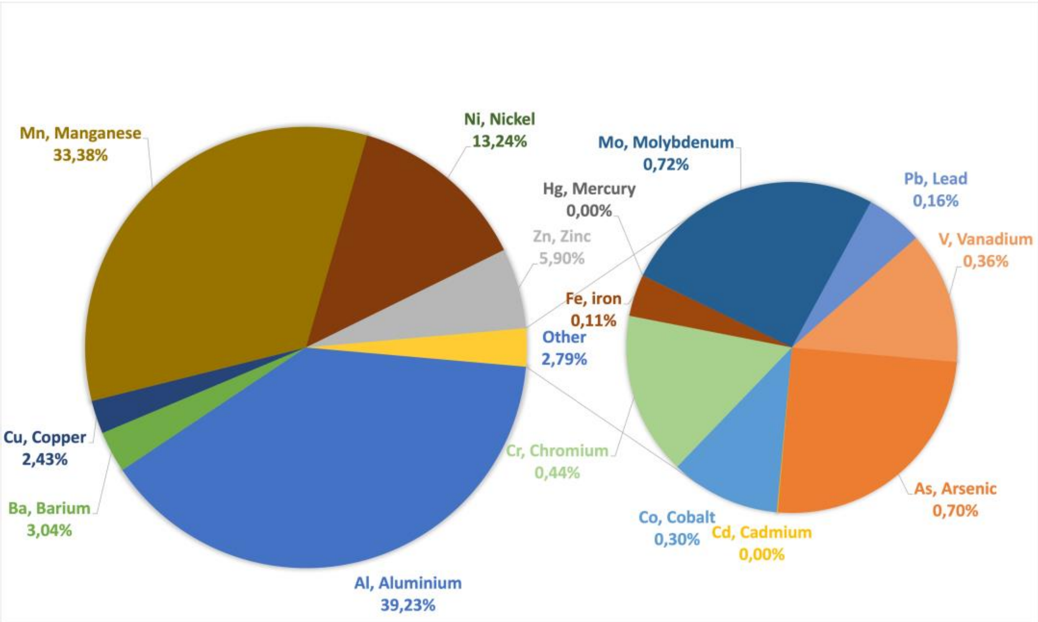

Figure 11. Sampling result of all metals after OWS with digestion, each metal is a mean value of all the vessel samples.

Copper without digestion. Vessel A and B values are below the PNEC for after the OWS. Vessel C, E, F and G values a value over PNEC. Vessel E and G are increasing after the OWS. The result for copper shows that most of the vessels are releasing copper far above the PNEC values, *Figure 12*.
Copper with digestion. All six vessels is over the limit value for copper. Vessel B, C and E are increasing the amount after the OWS, *Figure 13*.

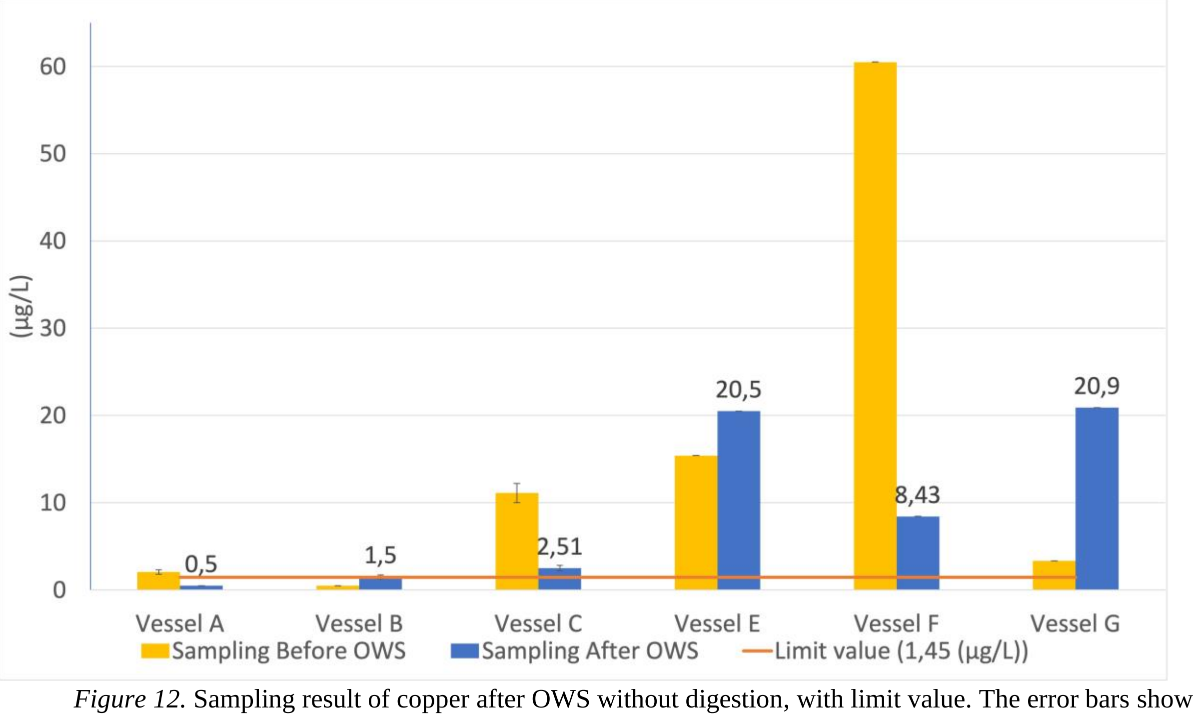

Figure 12. Sampling result of copper after OWS without digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 10,2 µg/L, after: 0,5 µg/L

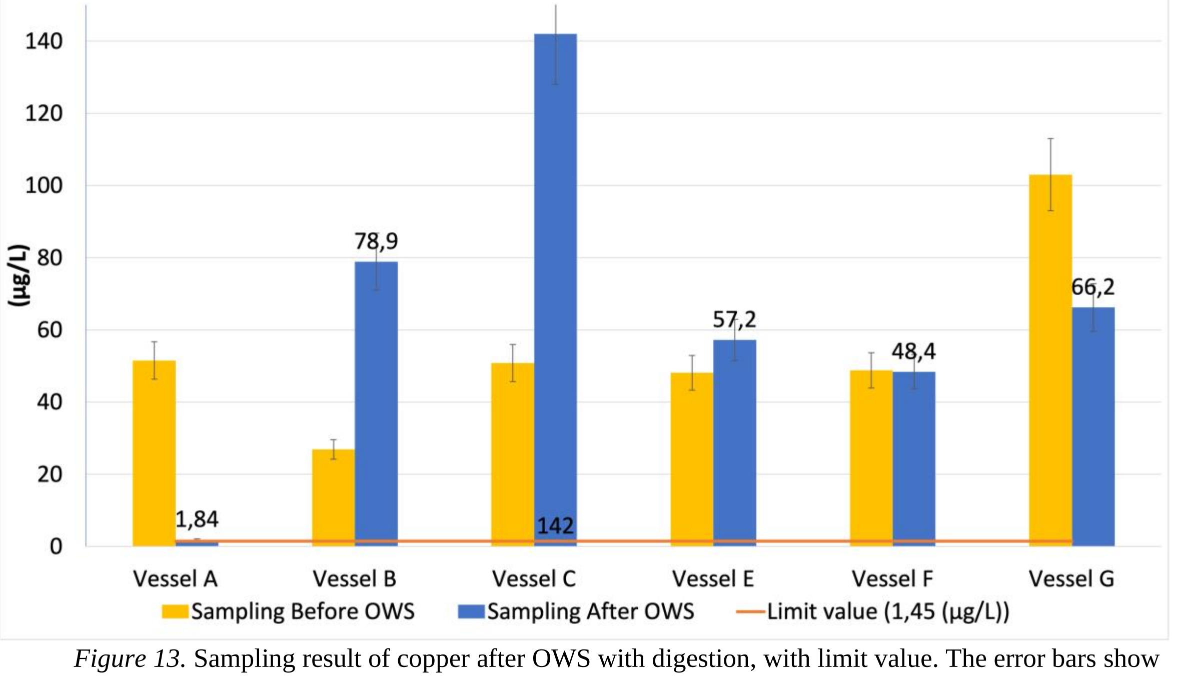

Figure 13. Sampling result of copper after OWS with digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 652 µg/L, after: 0,5 µg

Chromium without digestion. Vessel A, B, F and G are below the PNEC after the OWS. Vessel C and E, shows values above PNEC after the OWS. The result for Chromium shows that the concentration of chromium in the bilge water before and after are under the PNEC for vessel A and B. Vessel C and E are above the limit. Vessel F and G are reducing the concentration from near the PEC/PNEC value to far above the limit, *Figure 14*. Chromium with digestion. Vessel C, E and F are showing high concentrations after the OWS. All vessels except F are reducing concentration of chromium after the OWS, *Figure 15*.

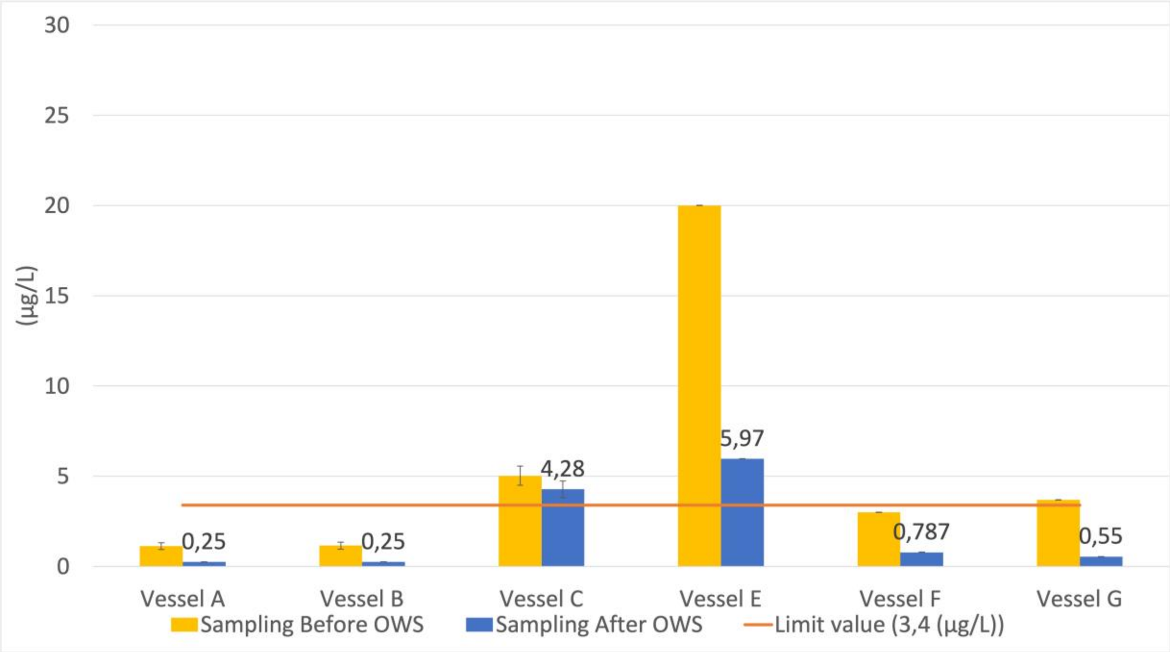

Figure 14. Sampling result of chromium after OWS with digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 26 µg/L, after: 0,25 µg/L

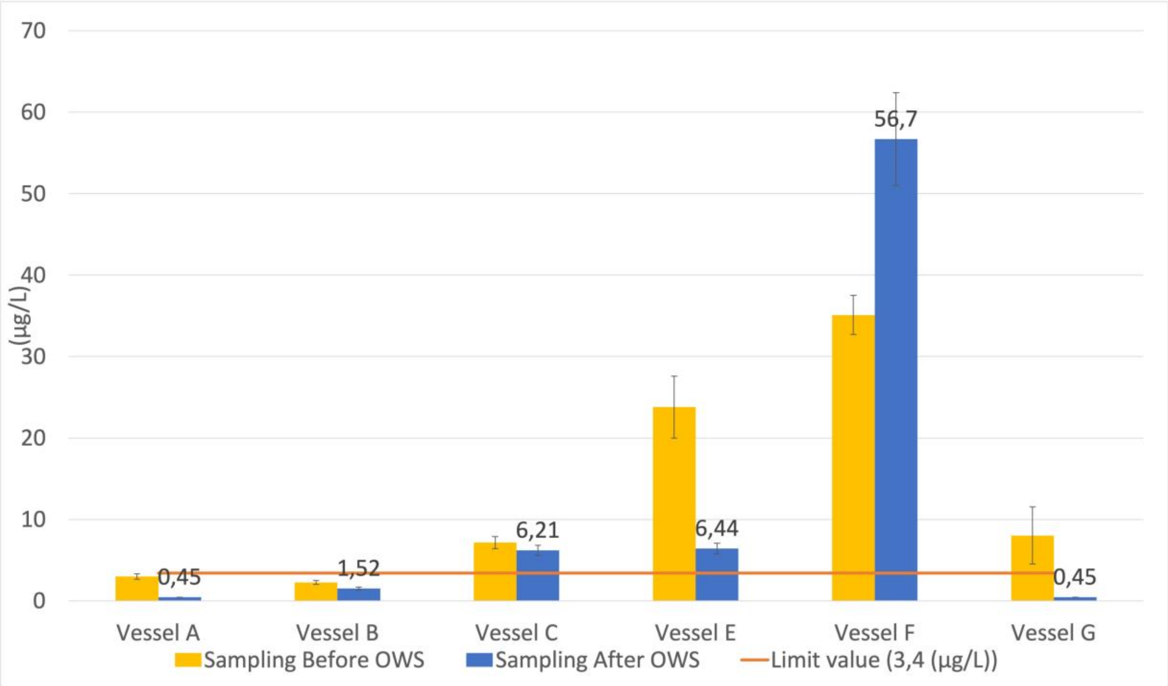

Figure 15. Sampling result of chromium after OWS with digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 38 µg/L, after: 0,5 µg.

Zinc without digestion. The concentration of zinc in the bilge water are between 30 to 380 times the PNEC value after the OWS. The OWS reduced the concentration of zinc in all six vessels, *Figure 16*.
Zinc with digestion. Zinc shows the same result with or without digestions. The concentrations are high, both before and after the OWS, *Figure 17*.

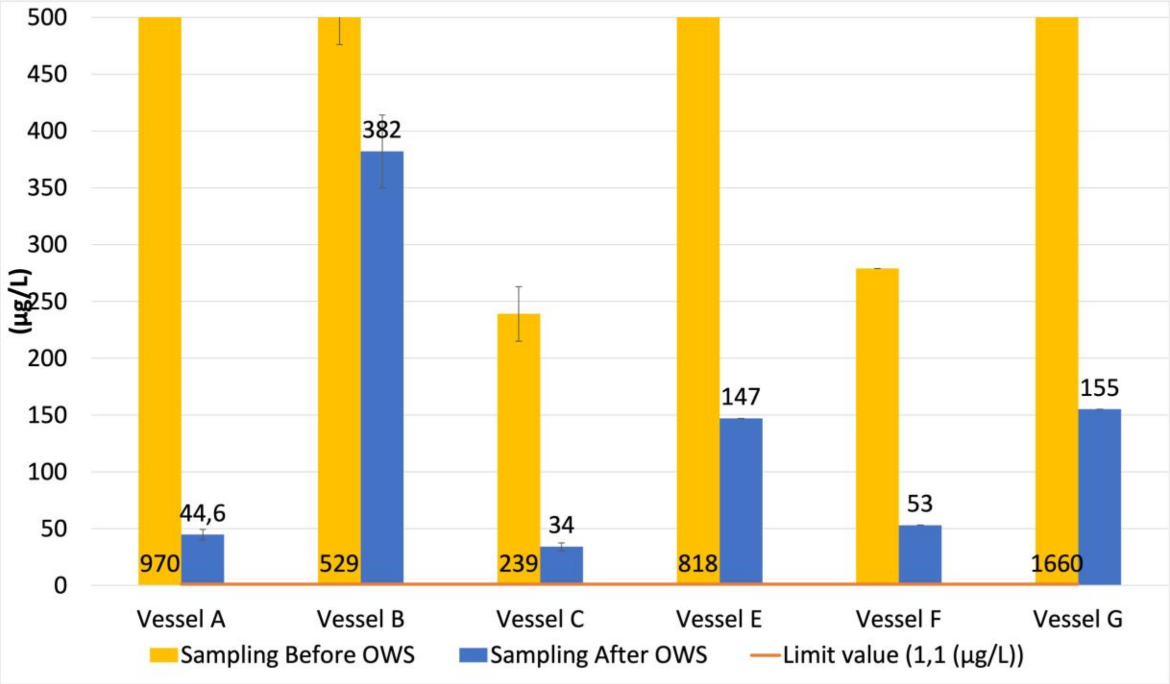

Figure 16. Sampling result of zinc after OWS without digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 3700 µg/L, after: 1 µg/L

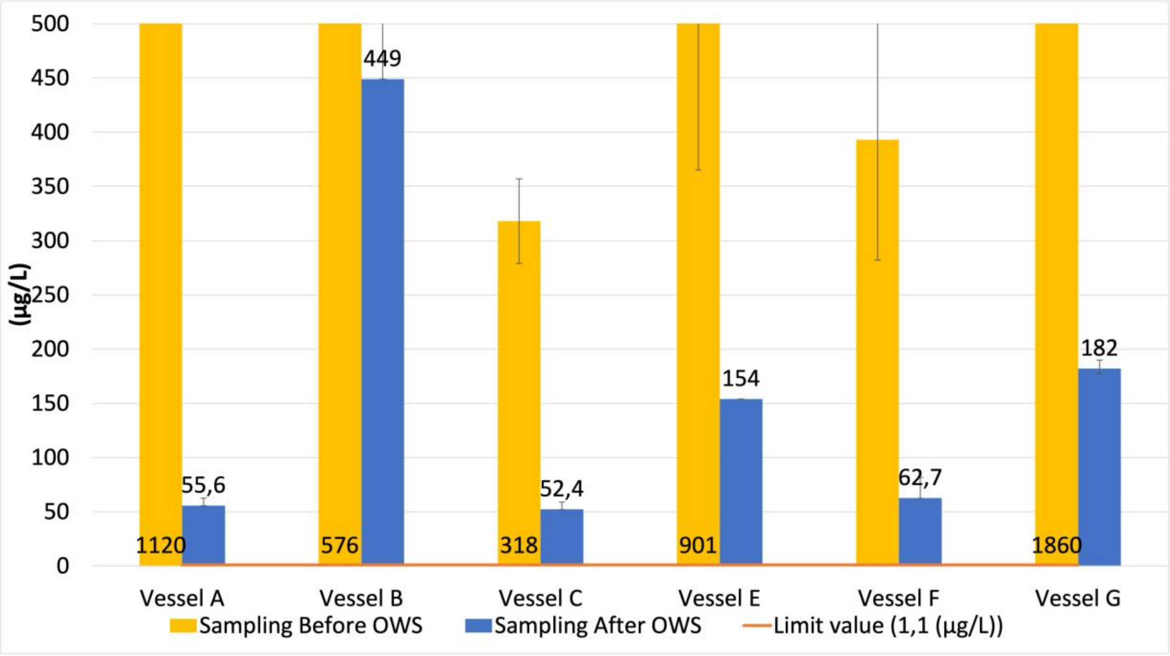

*Figure 17. S*ampling result of zinc after OWS without digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 4340 µg/L, after: 2 µg/L

Nickel without digestion. All vessels are above the PNEC value after the OWS. Nickel is increased for vessel C and the result from vessel F are 60 times higher than for the rest of the vessels, *Figure 18*.
Nickel with digestion. Nickel shows a slightly higher value. The concentrations are higher before and after the OWS, *Figure 19*.

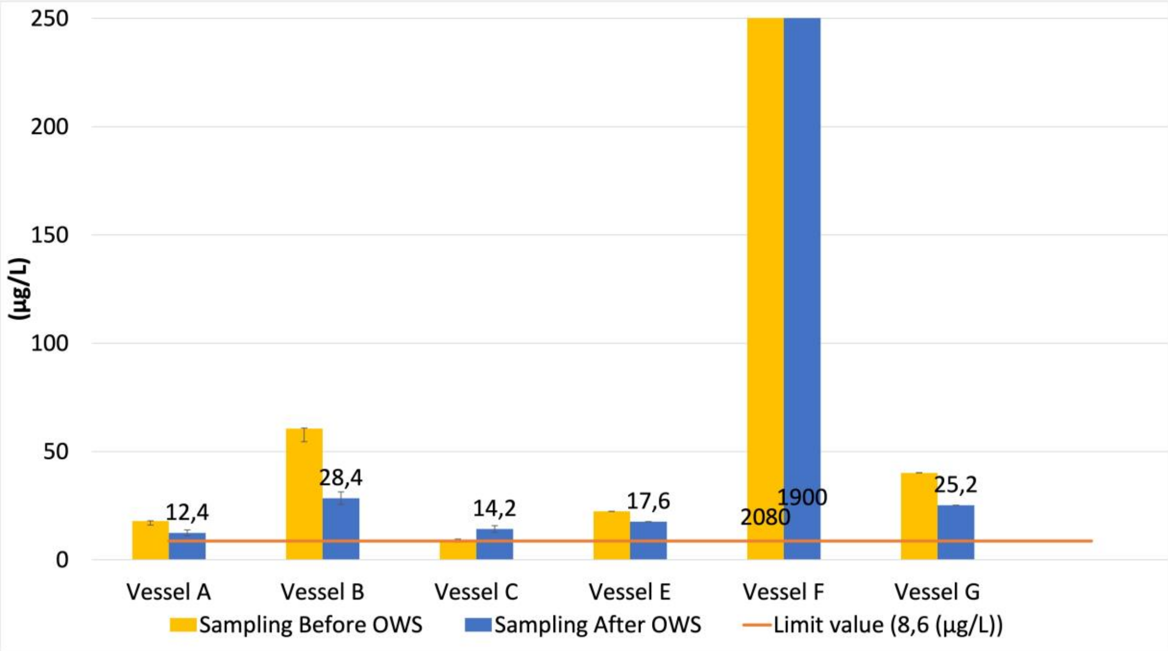

*Figure 18. S*ampling result of nickel after OWS without digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 197 µg/L, after: 13 µg/L

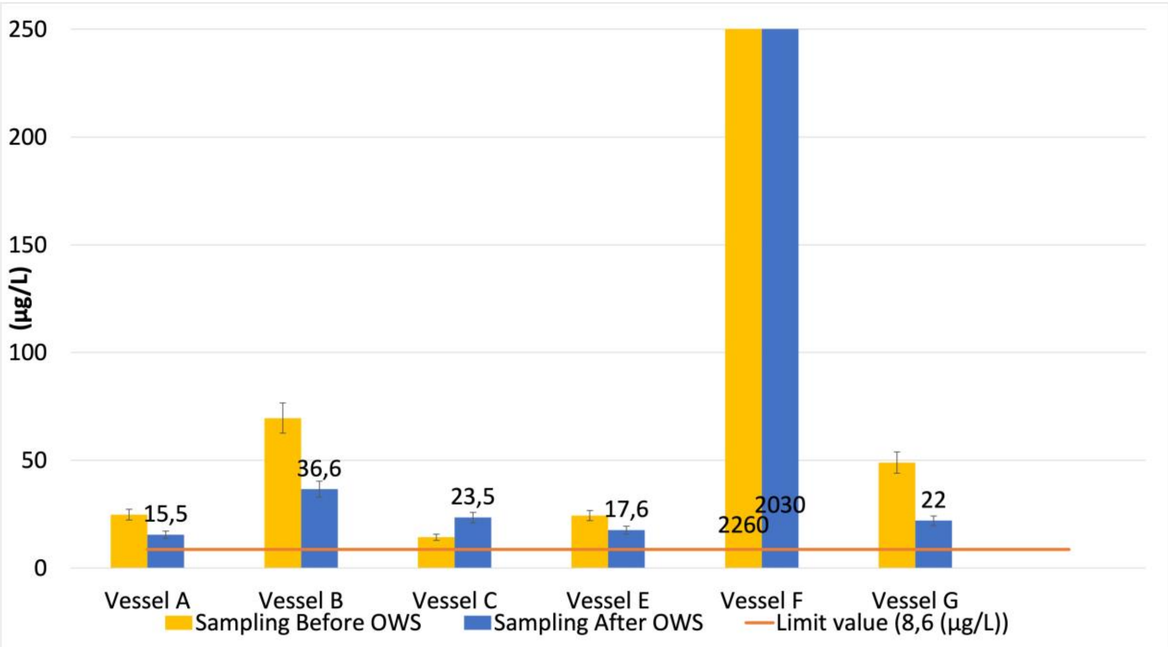

*Figure 19. S*ampling result of nickel after OWS with digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 313 µg/L, after: 16 µg/L

Lead without digestion. Vessel A and F are showing a decrease in lead after treatment. Vessel B, C, E and G are above the PEC/PNEC both before and after the OWS. Vessel B, C and G are increasing the concentration of lead after the OWS, *Figure 20*.
Lead with digestion. Lead is showing a higher concentration than without for all six vessel both before and after the OWS, *Figure 21*.

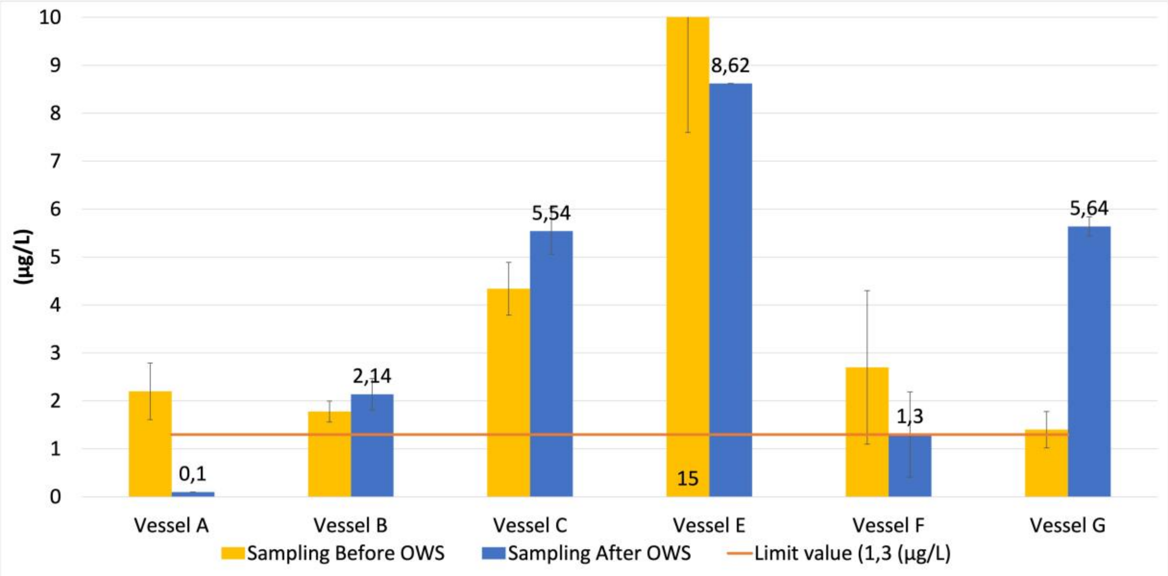

*Figure 20. S*ampling result of lead after OWS without digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 74 µg/L, after: 0,1 µg/L

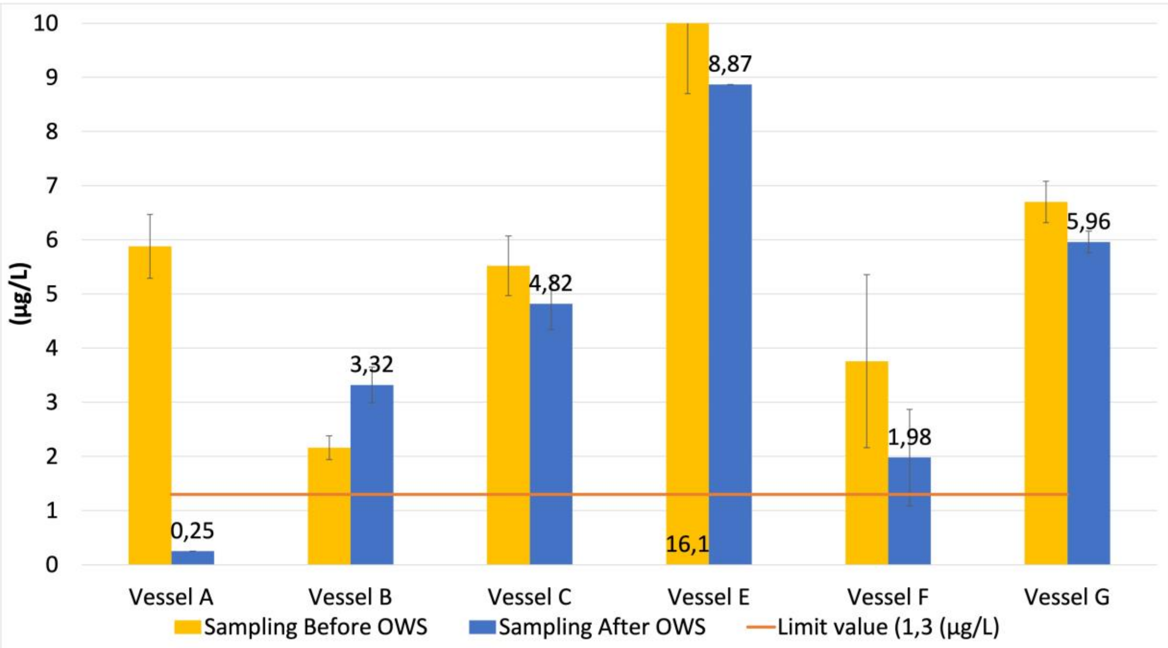

*Figure 21. S*ampling result of lead after OWS with digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 74 µg/L, after: 0,1 µg/L

Arsenic without digestion. Vessel A, C, E, F and G are above the PNEC value. Vessel B is below but the concentration has an increase. Vessel B, C and E are increasing after the OWS, *Figure 22*.
Arsenic with digestion. The value is high for all six vessels. The concentration is increasing for vessel C, E and F. The concentrations in vessel A, B and G are reduced, *Figure 23*.

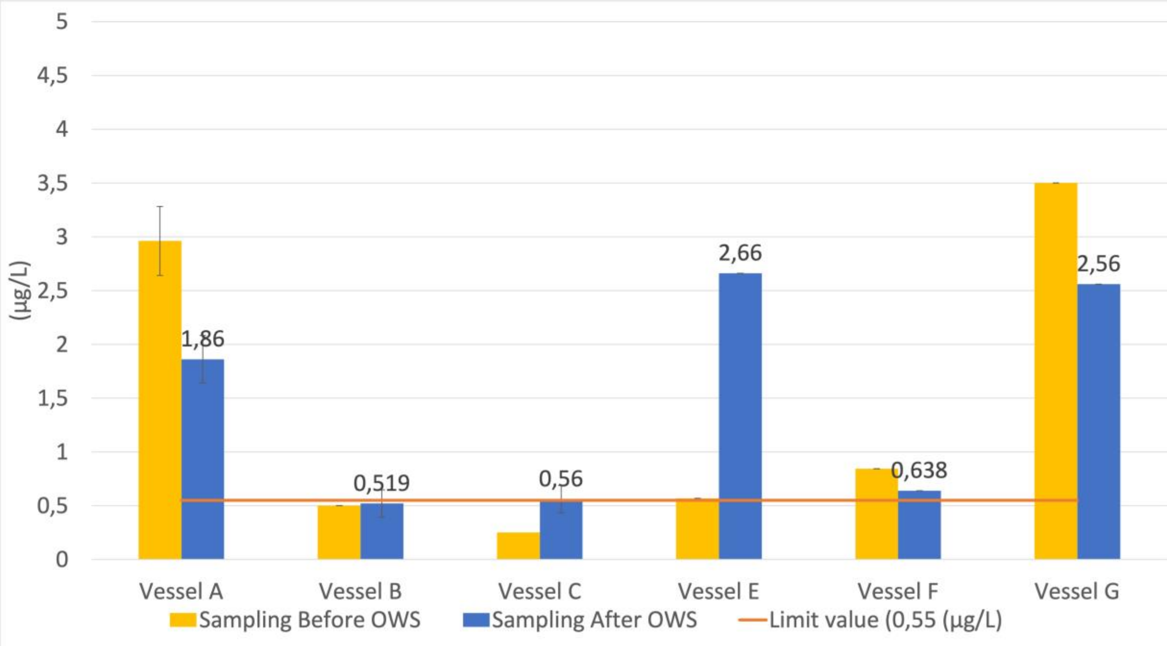

*Figure 22. S*ampling result of arsenic after OWS with digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 3 µg/L, after: 0,9 µg/L

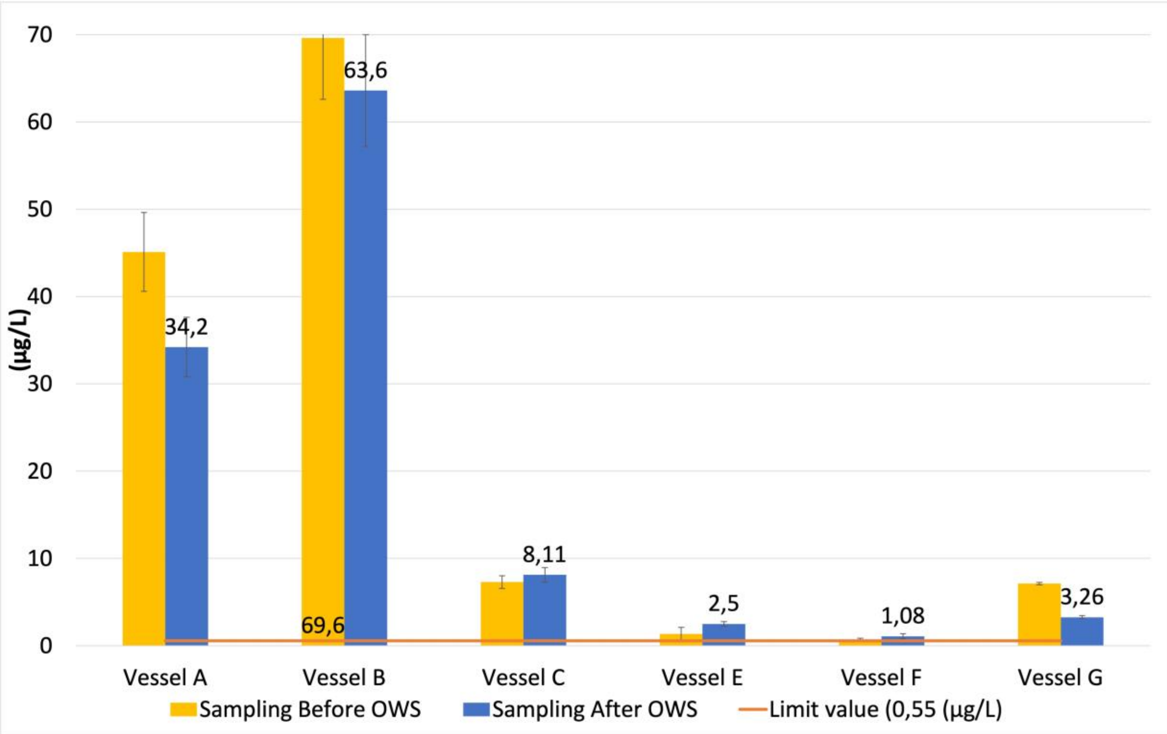

*Figure 23. S*ampling result of arsenic after OWS with digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 8 µg/L, after: 2 µg/L

Vanadium without digestion. Vessel E and F are above PNEC both before and after the OWS. Vessel A are below PNEC before and after the OWS. Vessel B, C and G are reducing its concentration of vanadium after OWS to below PNEC, *Figure 24*.
Vanadium with digestion. Vessel A, B, C and G are highly increased. Vessel F are decreased, *Figure 25*.

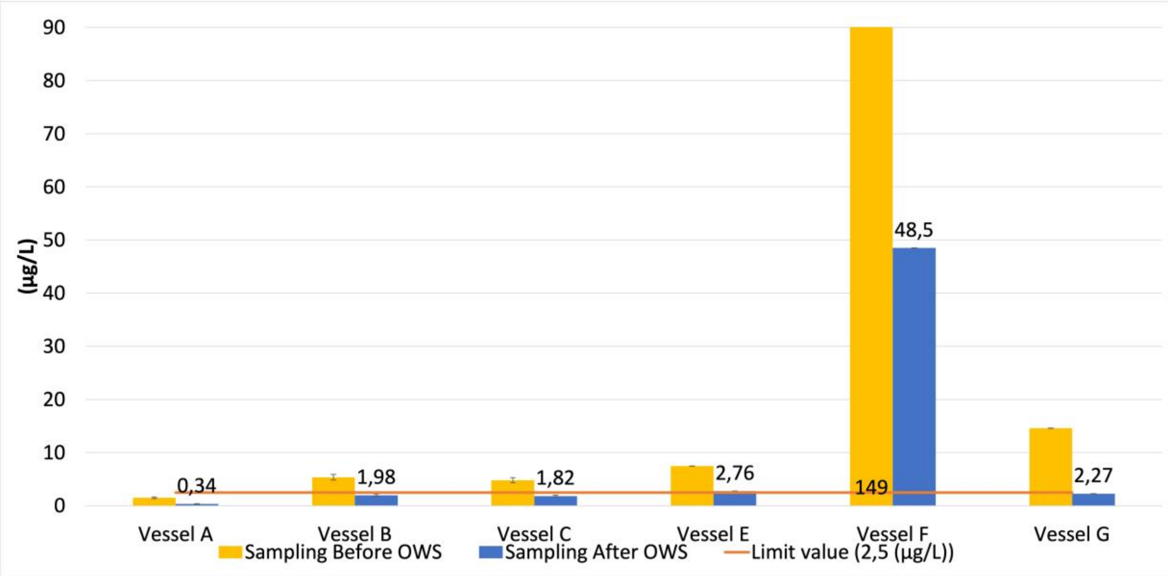

*Figure 24. S*ampling result of vanadium after OWS without digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 43 µg/L, after: 1,3 µg/L

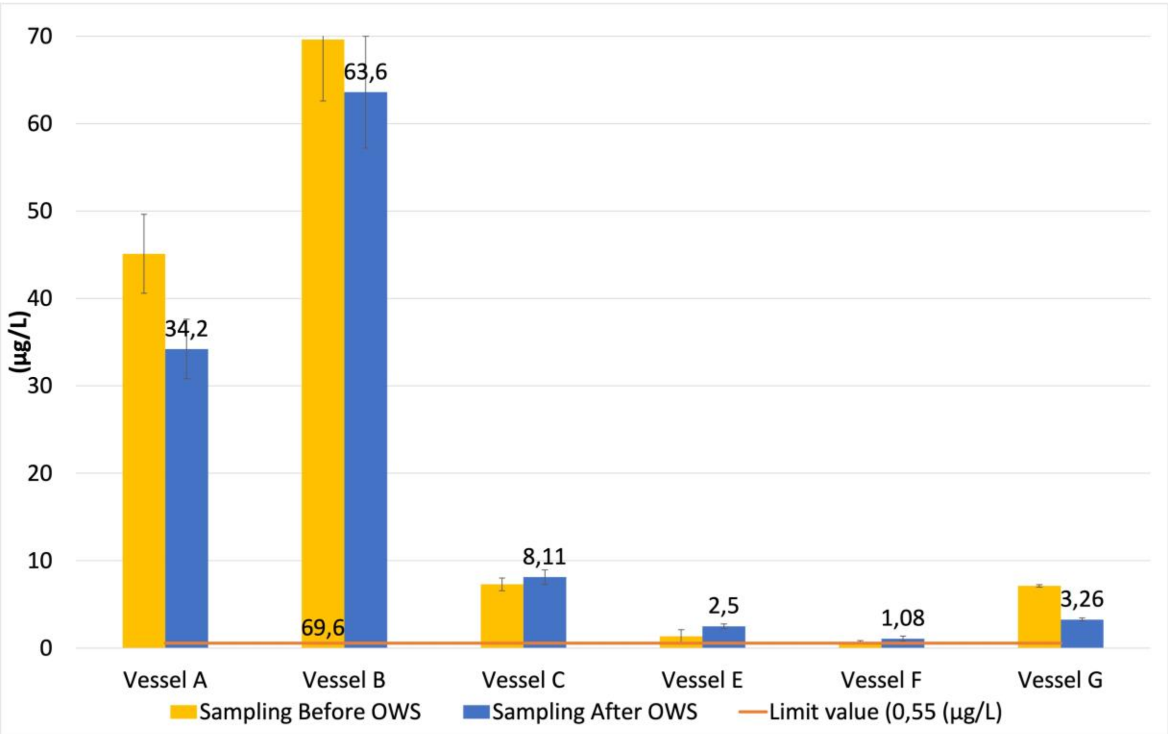

*Figure 25. S*ampling result of vanadium after OWS with digestion, with limit value. The error bars show measurement uncertainty according to ALS. Vessel D before: 47 µg/L, after: 1,3 µg/L.

4.4 PEC/PNEC ratios

The concentrations of zinc, nickel, phenanthrene, copper, vanadium, pyrene, lead, arsenic, naphthalene and fluoranthene, *Figure 26*, are above PNEC, the majority is metals and zinc stand for more than 50 %. Out of the 15 substances, this thesis handle for limit value, 11 is over the PNEC value. The total amount of Nickel, copper, arsenic and chromium increases after the digestion method, *Figure 27*. The ratio is calculated: $\frac{mean\ value\ after\ ows}{limit\ value}$.

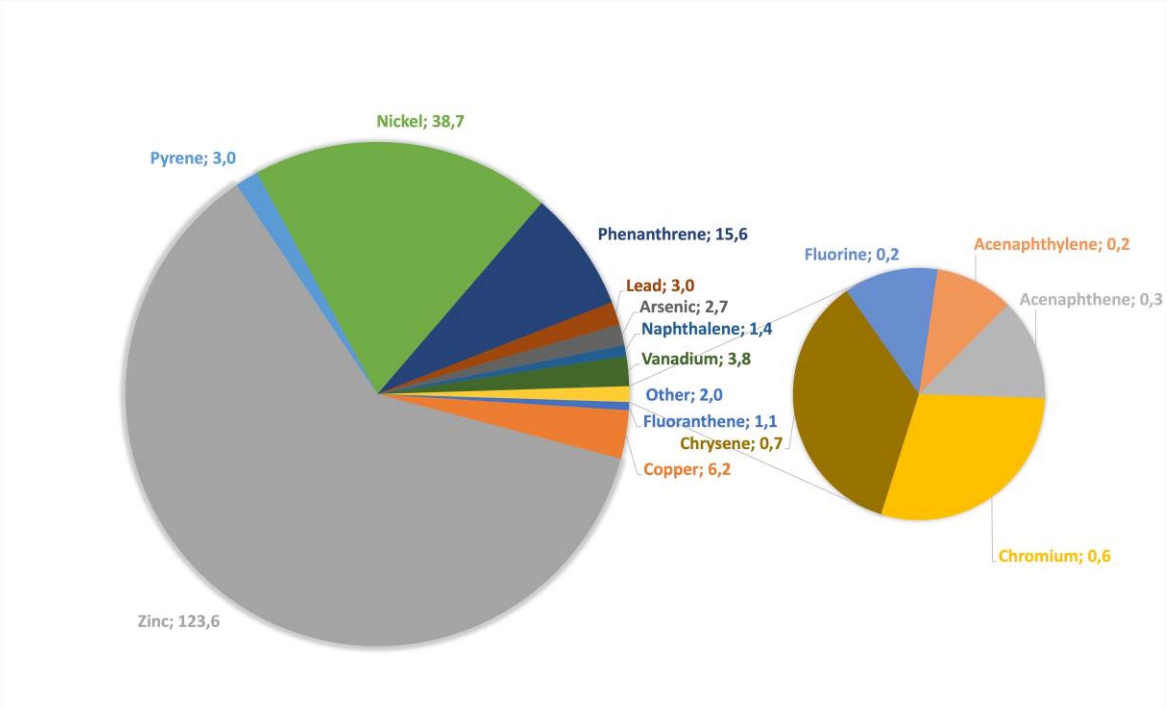

Figure 26 Ratio of PNEC ratios without digestion, from mean value of all vessels.

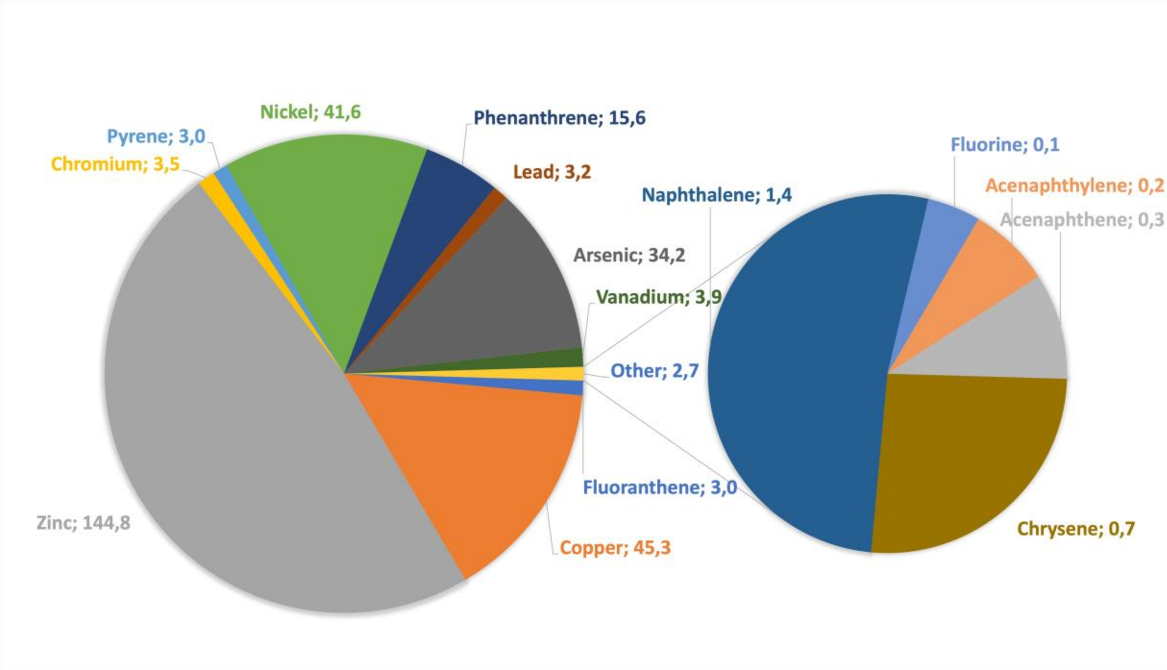

Figure 27. Ratio of PNEC ratios with digestion, from mean value of all vessels.

5. DISCUSSION

Bilge water is a complex cocktail of different organic and inorganic compounds. This complicates the process of separating the mixtures, as seen in the result. All the vessels have a unique mixture, almost like a fingerprint. It seems hard for the OWS manufacturers to produce an OWS that cover this wide spectrum and treat the different bilge water. Even though the majority uses coal filter, the filter does not remove all chemical substances as seen in the result. When looking into the regulations of discharge of bilge water, the main focus is to remove oil. This can be seen clearly in the result of how successful the OWS design are. Almost none of the PAH 16 is over the limit and when comparing with the result from PAH 16 to Tiselius & Magnusson (2017), the vessels in this report had a factor of 29 times lower. In Tiselius & Magnusson (2017) the writers does not specify what method the OWS were using, just that the samples are from Ro-Pax. This could be interesting to know since comparing the different methods could give an insight to why the result differs to this great extent. This thesis has not found any evidence that older vessels have more toxic bilge water than younger vessels.

The concentration of PAH in organic compounds is illustrated when analyzing test package 1. There are 16 different PAH that are controlled by ALS. There is a debate on with ones of the PAH that are cancerogenic or considered and / or harmful to mankind. According to Swedish Environmental Protection Agency (2017), 12 of them is considered to be cancerogenic. There are more then 16 PAH in the organic compound group and some of them could be harmful, this needs further research to clarify. This result could be very different when including more substances that have potential to be toxic, but since there is a standard for Swedish Environmental Protection Agency (2017) to check for these 16 different PAH, other organic substances have not been analyzed.

It is difficult to determine the toxicity for the SDS since there are a limited number of reports about the consequences for the marine environment. There are no official environmental quality standards or limit available and it is impossible to agree upon a limit without meticulous research. Researchers have shown that SDS can be harmful to marine plants and marine creatures during the creature's reproduction and growth Nilvea Ramalho Oliveira (2020). The long-term effect from SDS have not been researched.

When assessing the toxicity of the metal substances different method are used. This report is using PEC/PNEC as limit values used by the European Union. There are three major problems with the approach to use PNEC. Firstly, PNEC-values are not available for all the substances analyzed. So, to determine the total toxicity for bilge water more research is required. Secondly, the mixture toxicity of two substances, or more can have the potential to increase the toxicity than the metals affect the marine environment separately. Thirdly, the limit values are based on the premises of what is toxic for the environment and uses that as a measurement for a reasonable concentration level. There is also important to understand that the bilge water will be diluted when it comes in contact with the sea. So that the concentration of chemical compound in the sea might be lower than the PNEC value.

Where and when the bilge water is released are also factors were the PNEC value can differ. If the bilge water is released in a harbour, the impact it has on environment can increase drastically, if it was to be released in the middle of Atlantic where the water dilution is much higher. Since the water exchange is less in a harbour environment, the bilge water can accumulate in higher concentrations than on route over the Atlantic. The seasons can have a bigger impact to the limit value as well, at spring and summer more marine creatures and plants are reproducing and are more active than during the winter (Tiselius & Magnusson, 2017). The calculation for how much bilge water is an average from Tiselius & Magnusson, (2017). However, the values can show an inkling of how much a vessel of these size and type can produce.

The release of bilge water is not a continuous process. It happens sporadically and when the vessels tanks are full. All the bilge water accumulated from the past can have higher or lower concentrations of different chemical substances depending on what kind of maintenance the vessel is performing at the moment. The separator is cleaned routinely, the interval of this is depending on the type of fuel and how dirty the lubrication oil is. Cleaning the separator produces more dirty oil that are stored in the sludge tank. The sludge tank is then drained to the bilge water tank and thus increase the concentrations of all the PAHs. When a major engine failure has happened, changing of lubrication oil can be done, depending on what has happened. This leaves a lot of PAH and metals in the sludge, thus in the bilge water. The main source of SDS is coming from cleaning agents, which also can differ from day to day depending on the cleaning routine. A major cleaning day before sampling can alter the value for SDS in the bilge water thus creating higher values of SDS in the bilge water. This causes the results to differ, in order to make a complete result, the samples should be taken over several days.

5.1 PAH

The observed low concentrations of PAHs are a good indication on how well the chemical method is to remove oil and that the oil content monitoring is working. MARPOL regulation on prevention of oil from vessels shows it effect when looking on PAH. The mean result for the different organic substances is below 15 PPM. When looking at the result for the PAH separately, some are above the PNEC value. The result show a lower content of organic substances comparing to Tiselius & Magnusson, (2017). The data collected from the different vessel shows that the OWS reduces the organic compounds in the bilge water. When it comes to the reduction of metal and SDS it looks slightly differently. Metal and SDS are mostly reduced but not down to an overall acceptable level.

5.2 SDS

Looking on the OWS capability to reduce the concentration of SDS in the bilge water there are certain things to point out. The median number of SDS shows that the OWS only reduces the SDS with about 44 % its original value from before the OWS. When focusing on the results from different vessels it shows that the concentration of SDS can sometimes be higher after the OWS compered too before. As stated earlier in this report, there are not much documentation on the consequences of SDS on living organisms, no recommended values, no legislation from IMO nor from other different governments, and no focus on reducing the amount of SDS in the bilge water from the companies constructing the different types of OWS’s.

5.3 Metals

The metals found in the bilge water are evaluated after their PNEC values. These values are available for some of the metals. Research into the toxicity of metals is needed to produce regulations on limit values for all metals in bilge water. The combination of two different metals, or other toxic substances, can potentially increase the toxicity in the water more than the metals affect the marine environment separately. The metal concentration in bilge water is high, as it stands for 58 %, *Figure 6*, of the total chemical concentration in the bilge water after the OWS. Most of the vessels has a concentration of metals in the bilge water that exceeds the PNEC values after the OWS. Some are just slightly over or under the limit while some are excessively higher, like zinc. The vessels median value for zinc is a hundred times its acceptable PNEC value. The OWS are reducing the concentration of metals from an overall perspective, from 4390 ug/L to 4300 ug/L, which is a decrease of just 2% from its original value. This shows that even though the OWS are reducing the amount of metal, the result is far from satisfactory. The amount of lead in the bilge water shows that even metals with high density cannot be treated from the bilge water as effective, as it should.

In order for the problems with harmful toxicity from metals to be remedied there is a chain of events that needs to take place, and more investigation for the toxicity of metals, both individually and in mixture with each other.

Total concentrations of metals are not directly reflecting the toxicity of the metals. However, it can be viewed as an indication of potential toxicity and in a worst-case scenario, e.g. during acidic conditions, the metals could be transformed to bioavailable forms. Such worst-case conditions could be induced in case of intensive scrubber use in areas of limited water exchange. This digestion process can increase the mean value for copper with 625 % and increase the ratio for PNEC with 630 %. Arsenic is a very toxic metal that is bound in the bigger particles, it increases 1178 % when put through the digestion process (Bowell, R. et al., 2014). Even though the digestion process can occur it is most unlikely, and the consequences if it would happen in the oceans is catastrophic.

5.4 OWS Performance

The OWS used in Tiselius & Magnusson (2017) were of modern type and design, the same goes for the OWSs used in this thesis. Tiselius & Magnusson (2017) are also pointing out that older models are in use in other vessels, these models may give a worse result, than this thesis equipment have.

The OWS technic used by the vessels in this thesis are the chemical method. There would have been interesting to see if the result on SDS and metal would be the same if the OWS used another technic to treat the bilge water. Some of the methods could have been more effective in treating the bilge water from SDS or metals. The oil content meter that is used on the majority of vessels is scattered light principle, this method is simple, reliable and cost effective (Seebacher et al., 2018). The fluorescence method is not used since it is costly. The fluorescence method gives more accurate reading and are capable of reading much lower oil concentration than the scattered method (Malkov & Lowe, 2019).

5.5 Method discussion

To create more accurate values, the same engineers should have taken all the samples. When comparing the result with Tiselius & Magnusson (2017), it shows that the result is reasonable and the quantity of organic substances, SDS and metals is accurate. Recently performed maintenance should have been discussed with the crew onboard. This could have been made to get a more accurate background information about what the values represent. The questionnaire sent out to be filled in and returned with the samples was missing a lot of information needed to evaluate the result taken. The form was designed in such a way so that the most essential information was collected. During the writing process a lot of information about the vessels was found to be missing, for example the rate of bilge water discharge, what detergent is poured into the bilge water, how often the bilge water separator run e.g. The questionnaire could have been more in-depth.

The reason for focusing on Swedish vessels is the geographical area in which the vessels operate. It also helped the shipping of the samples, as the majority of the samples were sent to the headquarters of the shipping owners and then distributed to the vessels. The thesis had a time limit of approximately six months, so the samples had to be done quickly in order for the samples to be analyzed. The reason why the answering rate was around ten percentage, is because many vessels send their bilge water to reception facilities ashore. The OWS is therefore cleaned and in storage mode to save on expenses. Also, during this thesis period, the covid-19 pandemic was and still are, putting economical pressure on the shipping industries, which causes the vessel owners to make cut down on staff, this made the vessels understaffed and the crews over worked. Shipowners used these reasons to why not participating.

6. CONCLUSION

The OWS is generally good at treating bilge water from PAHs, even the SDS are reduced after being treated. The metal result in this thesis shows how bad of a design the OWS is for treating bilge water from metals. The aim of this study was to focus on the metals being released into the ocean, the actual impact on the environments needs more research. The *Figure 26* shows the ratio of all the toxic compounds and which compound is exceeding the most. Zinc, nickel and copper should have the most focus to remove from bilge water, since these contributed to the toxicity the most. The age of the vessels cannot predict the quality of the treating process, the model and how well the OWS is performing is more important.

The manufacturers for OWS are constructing their product to reduce the oil content to be below 15 PPM, following the legislation set by MARPOL (1983). The need for new legislations from IMO regarding the metal content in bilge water needs to be in place. When new regulation is in place the shipowner will demand new products to meet the regulation.

The question about if coal filter produces cleaner bilge water cannot be answered. There aren't enough studies performed on the subject is not to be included in the result.

6.1 Recommendations for further research

More research must be done to precisely determine the effect the bilge water has on the environment. In order to get more accurate value, the need for more sample and more sample on the same vessels. Since the production of bilge water can change week to week, there is a need for more data need to be collected over time. The environmental impact of SDS, has not been determined, more research can provide a PNEC value. The consequences for the environment with metals in a mixture needs more research, also other metals that were analyzed that have not been researched. The research for other sensor that can detect non-organic substances in bilge water.

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APPENDIX

Appendix A Letter to Swedish Vessel Owners

Till Svenska redare.

Vi är två studenter som läser sista året på sjöingenjörslinjen på Chalmers tekniska högskola, Göteborg. Under våren skall vi skriva vårt examensarbete och vi tänkte undersöka om det finns några kemikalier kvar i vattnet efter att det gått igenom en länsvattenseparator / OWS. Vi hoppas kunna visa att vattnet som pumpas ut är rent från kemikalier, eller om fallet är att kemikalier finns kvar, undersöka konsekvenserna och informera företagen som tillhandahåller utrustningen om resultatet så att de kan utveckla sin produkt för att minska föroreningarna.

Just nu samlar vi in vattenprover för att kunna skriva vårt examensarbete. Proverna kommer att skickas på kemisk analys för att se vilken typ och mängd kemikalier som finns kvar. Vi vill även ha information om modell och tillverkare av länsvattenseparartorn.

Vi kommer självklart att beskriva varje provresultat anonymt.

Där det är möjligt kommer vi gärna och tar proverna. Skulle detta vara uteslutet pga fartygets rutt eller den rådande Covid-pandemin så hoppas vi att ni kan skicka ett prov till oss. Vi skickar i så fall provtagningsbehållare till er och står för fraktkostnaderna.

Vi hoppas att ni vill vara med att undersöka och utveckla dagens teknik mot en mer hållbar sjöfart med minskad miljöpåverkan.

Då det är angeläget för oss att komma igång, skulle vi vilja be om ert svar per e-mail den 18 / 12 – 2020. Om ni har några frågor kan ni antingen maila eller ringa oss.

Med vänlig hälsning

Mattias Isaksson
matisaks@student.chalmers.se
070-2418228

Marcus Möller
mmoller@student.chalmers.se
070-8601482

Appendix B Guide to bilge water sampling

Guide to bilgewater sampling.

Information regarding documentation.
We need you to fill in the question form regarding machinery, with the best of your knowledge. If this document is missing, you can find it at:
https://forms.gle/HSRJ2WUosEPFpmym8 or with this QR:

Or request it from us by sending a mail to us at:
matisaks@student.chalmers.se or
mmoller@student.chalmers.se

Information regarding samples.
You have received a total of 4 bottles. These are color-coded for sampling before (red) and after (blue) the OWS.

Step 1. Use the plastic gloves, provided in the testing kit.

Step 2.
Take two bottles, one glass and one plastic marked with **BEFORE** and has a red label.
Locate the samplings point **BEFORE** the OWS.
Fill the bottles up and empty them, this to produce the cleanest sample possible.
Fill the bottles up again, fill them as much as possible and replace the lid.

Step 3.
Take the two blue bottles, one glass and one plastic marked **AFTER**.
Locate the samplings point **AFTER** the OWS.
Fill the bottles up and empty them, this to produce the cleanest sample possible.
Fill the bottles up again, fill them as much as possible and replace the lid.

Step 4.
After the sample is taken, pls sign with vessel name and date.

Step 5.
Repack the bottles in cardboard box and send it back to your office.

Thank you for your cooperation!

Mattias Isaksson Marcus Möller

Appendix C Questionnaire

Investigation of machinery space due to thesis at Marine Engineering program Chalmers University

Complementing information for the test results. These questions are relevant for us to create a picture of the machinery space. Some of the questions may not have a direct answer but we want you to answer approximately.

This form is containing questions for the bilgewater separator test.

General questions: 1-12

Bilgewater separator: 13-21

This form will take 10-15 minutes to fill in.

The answers may be used in the report if it's relevant for the conclusion, however name of the ship or information that may reveal your ship will be excluded.

We hope that you will find this interesting and are willing to answer as thoroughly as possible.

These questions is also printed and sent with the sample kit. If You want, you can also write Your answers there. You can either scan in the result and email us or send it with the samples.

Marcus: mmoller@student.chalmers.se
Mattias: matisaks@student.chalmers.se

Have a great day!
Yours Sincerely,
Marcus and Mattias
*Obligatorisk

1. Name of the ship *

Answer: ____

2. Sea-area of the ship when the test result was taken? *

Answer: ____

3. Time (UTC) and date *

Answer: ____

4. What type of propulsion system do you use? (Diesel-electric, shaft with reduction gear box etc)

Answer: ____

5. Main Engine(s), Model and Make: *

Answer: ____

6. Number of Main Engine(s)

☐ 1
☐ 2
☐ 3
☐ 4
☐ 5

7. Running hours (main engine) *

Answer: ____

8. Fuel for the main engine *

☐ HFO
☐ ULSFO (Ulta-low-sulphur-fueloil)
☐ Diesel
☐ LNG
☐ Other ____

9. Auxillary Engines, Model and Make:

Answer: ____

10. Number of auxiliary engine

☐ 1
☐ 2

☐ 3
☐ 4
☐ 5

11. Running hours for auxiliary engine

Answer: ____

12. Do you use scrubber?
☐ Yes
☐ No

13. Manufacturer for lube-oil/fuel separator?

Answer: ____

14. How often do you CIP the separators (Clean in place)?
☐ Once per month
☐ Once every half-year
1. Other ____

15. What type of brand is the cleaning detergent?

Answer: ____

16. If you would to approximate, how much cleaning detergent do you use in a month? (in liters)

Answer: ____

17. What type of manufacturer and model of bilge water separator do you have?

Answer: ____

18. Do you send bilge water ashore?
☐ Yes
☐ No
1. Other ____

19. Do you have a bilge water separator tank?

☐ Yes

☐ No

2. Other ____

20. Do you think that chemicals or heavy metals runs through the bilge water separator?

☐ Yes

3. No

21. Do your bilge-water separator use coal filter?

☐ Yes

☐ No

4. Other ____

Appendix D Result from ALS

Analyscertifikat

Ordernummer	: **ST2105287**	Sida	: 1 av 13
Kund	: **Chalmers Tekniska Högskola**	Projekt	: Länsvatten
Kontaktperson	: Ida-Maja Hassellöv	Beställningsnummer	: 303032, 30IDHAS1
Adress	: Hörselgången 4 412 96 Göteborg Sverige	Provtagare Provtagningspunkt Ankomstdatum, prover	: ---- : ---- : 2021-03-10 07:00
E-post	: ida-maja@chalmers.se	Analys påbörjad	: 2021-03-12
Telefon	: ----	Utfärdad	: 2021-03-23 09:29
C-O-C-nummer (eller Orderblankett-nummer)	: ----	Antal ankomna prover	: 30
Offertnummer	: ST2021SE-CHA-TEK0001 (OF210027)	Antal analyserade prover	: 30

Generell kommentar

Orderkommentar

-

Prover ST2105287/001, 003, 005, metod W-PAHGMS05 innehåller en oljefilm, analysen utfördes på hela provet.
Prov -007, metod W-TPHFID01, innehåller en oljefilm, analysen utfördes på hela provet.

Signatur	*Position*
Niels-Kristian Terkildsen	Laboratoriechef

Laboratorium	: ALS Scandinavia AB	hemsida	: www.alsglobal.com
Adress	: Rinkebyvägen 19C 182 36 Danderyd Sverige	E-post Telefon	: info.ta@alsglobal.com : +46 8 5277 5200

Analysresultat

Matris: **HAVSVATTEN**

Provbeteckning	**01 Vessel A Before OWS**						
Laboratoriets provnummer	*ST2105287-001*						
Provtagningsdatum / tid	*2021-03-10*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	14.9	± 4.46	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	0.189	± 0.057	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	0.431	± 0.129	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	2.62	± 0.787	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	5.05	± 1.52	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	0.717	± 0.215	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.421	± 0.126	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	1.54	± 0.461	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	0.144	± 0.043	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	0.146	± 0.044	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	0.151	± 0.045	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	0.030	± 0.009	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	0.106	± 0.0319	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	0.019	± 0.006	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	0.260	± 0.078	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	0.077	± 0.023	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	26.8	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	0.673	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	26.1	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	15.5	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	10.3	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	0.933	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning	11 Vessel A After OWS					
	Laboratoriets provnummer	ST2105287-002					
	Provtagningsdatum / tid	2021-03-10					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Polycykliska aromatiska kolväten (PAH)							
naftalen	6.63	± 1.99	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	0.087	± 0.026	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	0.035	± 0.010	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	0.701	± 0.210	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	0.433	± 0.130	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	0.070	± 0.021	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.010	± 0.003	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	0.047	± 0.014	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	8.01	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	8.01	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	6.75	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	1.26	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**	Provbeteckning	**21 Vessel B Before OWS**					
	Laboratoriets provnummer	ST2105287-003					
	Provtagningsdatum / tid	2021-03-10					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Polycykliska aromatiska kolväten (PAH)							
naftalen	1.10	± 0.329	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	0.051	± 0.015	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	0.116	± 0.035	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	0.400	± 0.120	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	0.478	± 0.144	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	0.099	± 0.030	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.109	± 0.032	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	0.525	± 0.158	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	0.053	± 0.016	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	0.085	± 0.025	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	0.065	± 0.019	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	0.016	± 0.005	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	0.0559	± 0.0168	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	0.122	± 0.036	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	0.036	± 0.011	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	3.31	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	0.311	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	3.00	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	1.27	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	1.61	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	0.433	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**	Provbeteckning	31 Vessel B After OWS					
	Laboratoriets provnummer	ST2105287-004					
	Provtagningsdatum / tid	2021-03-10					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Polycykliska aromatiska kolväten (PAH)							
naftalen	0.691	± 0.207	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	0.022	± 0.006	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	0.046	± 0.014	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	0.106	± 0.032	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	0.078	± 0.023	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.010	± 0.003	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	0.032	± 0.009	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	0.985	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	0.985	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	0.759	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	0.226	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning	41 Vessel C Before OWS					
	Laboratoriets provnummer	ST2105287-005					
	Provtagningsdatum / tid	2021-03-10					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Polycykliska aromatiska kolväten (PAH)							
naftalen	14.3	± 4.29	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	0.240	± 0.072	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	1.86	± 0.559	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	6.80	± 2.04	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	1.68	± 0.504	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	0.943	± 0.283	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.424	± 0.127	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	2.33	± 0.699	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	0.136	± 0.041	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	0.159	± 0.048	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	0.089	± 0.027	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	0.019	± 0.006	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	0.0658	± 0.0197	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	0.106	± 0.032	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	0.045	± 0.014	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	29.2	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	0.514	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	28.7	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	16.4	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	12.2	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	0.620	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning	51 Vessel C After OWS
	Laboratoriets provnummer	ST2105287-006
	Provtagningsdatum / tid	2021-03-10

Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Polycykliska aromatiska kolväten (PAH)							
naftalen	9.85	± 2.95	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	0.035	± 0.010	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	0.413	± 0.124	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	0.367	± 0.110	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	0.049	± 0.015	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	0.011	± 0.003	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	10.7	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	10.7	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	10.3	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	0.427	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning	02 Vessel A Before OWS
	Laboratoriets provnummer	ST2105287-007
	Provtagningsdatum / tid	2021-03-10

Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Petroleumkolväten							
oljeindex, fraktion C10 - C40	39000	± 11700	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	1490	± 448	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	3760	± 1130	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	27100	± 8120	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	6700	± 2010	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

	Provbeteckning	12 Vessel A After OWS
	Laboratoriets provnummer	ST2105287-008
	Provtagningsdatum / tid	2021-03-10

Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Petroleumkolväten							
oljeindex, fraktion C10 - C40	714	± 214	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	28.0	± 8.4	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	47.2	± 14.2	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	548	± 164	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	90.7	± 27.2	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

Provbeteckning	22 **Vessel B Before OWS**						
Laboratoriets provnummer	ST2105287-009						
Provtagningsdatum / tid	2021-03-10						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	155	± 46.5	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	5.8	± 1.8	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	12.5	± 3.8	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	122	± 36.6	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	14.8	± 4.4	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

Provbeteckning	32 **Vessel B After OWS**						
Laboratoriets provnummer	ST2105287-010						
Provtagningsdatum / tid	2021-03-10						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	298	± 89.5	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	13.9	± 4.2	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	51.0	± 15.3	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	207	± 62.1	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	26.4	± 7.9	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

Provbeteckning	42 **Vessel C Before OWS**						
Laboratoriets provnummer	ST2105287-011						
Provtagningsdatum / tid	2021-03-10						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	<50.0	----	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	<30.0	----	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	<10.0	----	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

Provbeteckning	52 **Vessel C After OWS**						
Laboratoriets provnummer	ST2105287-012						
Provtagningsdatum / tid	2021-03-10						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	63.0	± 18.9	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	14.7	± 4.4	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	32.8	± 9.8	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	<30.0	----	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	<10.0	----	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**03 Vessel A Before OWS**				
	Laboratoriets provnummer		ST2105287-013				
	Provtagningsdatum / tid		2021-03-10				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	3.10	± 0.621	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**13 Vessel A After OWS**				
	Laboratoriets provnummer		ST2105287-014				
	Provtagningsdatum / tid		2021-03-10				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	2.93	± 0.586	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**23 Vessel B Before OWS**				
	Laboratoriets provnummer		ST2105287-015				
	Provtagningsdatum / tid		2021-03-10				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	1.67	± 0.335	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**33 Vessel B After OWS**				
	Laboratoriets provnummer		ST2105287-016				
	Provtagningsdatum / tid		2021-03-10				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	1.38	± 0.276	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**43 Vessel C Before OWS**				
	Laboratoriets provnummer		ST2105287-017				
	Provtagningsdatum / tid		2021-03-10				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	3.83	± 0.766	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**

Provbeteckning	**53 Vessel C After OWS**						
Laboratoriets provnummer	*ST2105287-018*						
Provtagningsdatum / tid	*2021-03-10*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	2.17	± 0.433	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**

Provbeteckning	**04 Vessel A Before OWS**						
Laboratoriets provnummer	*ST2105287-019*						
Provtagningsdatum / tid	*2021-03-10*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	0.29 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning	**14 Vessel A After OWS**						
Laboratoriets provnummer	*ST2105287-020*						
Provtagningsdatum / tid	*2021-03-10*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning	**24 Vessel B Before OWS**						
Laboratoriets provnummer	*ST2105287-021*						
Provtagningsdatum / tid	*2021-03-10*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning	**34 Vessel B After OWS**						
Laboratoriets provnummer	*ST2105287-022*						
Provtagningsdatum / tid	*2021-03-10*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**					Provbeteckning	44 Vessel C Before OWS	
					Laboratoriets provnummer	ST2105287-023	
					Provtagningsdatum / tid	2021-03-10	
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Övriga parametrar							
katjoniska tensider	0.56 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**					Provbeteckning	54 Vessel C After OWS	
					Laboratoriets provnummer	ST2105287-024	
					Provtagningsdatum / tid	2021-03-10	
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Övriga parametrar							
katjoniska tensider	0.63 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**					Provbeteckning	05 Vessel A Before OWS	
					Laboratoriets provnummer	ST2105287-025	
					Provtagningsdatum / tid	2021-03-10	
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
nonjoniska tensider	0.41	± 0.16	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**					Provbeteckning	15 Vessel A After OWS	
					Laboratoriets provnummer	ST2105287-026	
					Provtagningsdatum / tid	2021-03-10	
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
nonjoniska tensider	0.57	± 0.18	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**					Provbeteckning	25 Vessel B Before OWS	
					Laboratoriets provnummer	ST2105287-027	
					Provtagningsdatum / tid	2021-03-10	
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
nonjoniska tensider	0.54	± 0.17	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**		Provbeteckning	35 **Vessel B After OWS**					
		Laboratoriets provnummer	ST2105287-028					
		Provtagningsdatum / tid	2021-03-10					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
nonjoniska tensider	0.47	± 0.16	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**		Provbeteckning	45 **Vessel C Before OWS**				
		Laboratoriets provnummer	ST2105287-029				
		Provtagningsdatum / tid	2021-03-10				
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
nonjoniska tensider	2.85	± 0.58	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**		Provbeteckning	55 **Vessel C After OWS**				
		Laboratoriets provnummer	ST2105287-030				
		Provtagningsdatum / tid	2021-03-10				
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
nonjoniska tensider	2.72	± 0.56	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Metodsammanfattningar

Analysmetoder	*Metod*
W-SURA-CFA	Spektrofotomtrisk bestämning av anjoniska tensider genom mätning av metylenblått index (MBAS) enligt metod CSN ISO 16265, SKALAR och CSN EN 903.
W-SURC-PHO*	Bestämning av katjoniska tensider med bromfenolblå (BAC) enligt intern metod.
W-SURN2-PHO	Bestämning av nonjoniska tensider (BiAS) spektrofotometriskt med en HACH kyvett enligt intern metod.
W-PAHGMS05	Bestämning av polycykliska aromatiska kolväten, PAH (16 föreningar enligt EPA), enligt metod baserad på US EPA 8270D, US EPA 8082A, CSN EN ISO 6468 och US EPA 8000D. Mätning utförs med GC-MS eller GC-MS/MS. PAH cancerogena utgörs av bens(a)antracen, krysen, bens(b)fluoranten, bens(k)fluoranten, bens(a)pyren, dibens(ah)antracen och indeno(123cd)pyren. Bestämning av polycykliska aromatiska kolväten; summa PAH L, summa PAH M och summa PAH H. Summa PAH L: naftalen, acenaften och acenaftylen. Summa PAH M: fluoren, fenantren, antracen, fluoranten och pyren. Summa PAH H: bens(a)antracen, krysen, bens(b)fluoranten, bens(k)fluoranten, bens(a)pyren, indeno(1,2,3-c,d)pyren, dibens(a,h)antracen och bens(g,h,i)perylen). PAH summorna är definerade enligt direktiv från Naturvårdsverket utgivna i oktober 2008.
W-TPHFID01	Bestämning av oljeindex enligt metod CSN EN ISO 9377-2, US EPA 8015, US EPA 3510, TNRCC Metod 1006. Mätning utförs med GC-FID.

Nyckel: **LOR** = Den rapporteringsgräns (LOR) som anges är standard för respektive parameter i metoden. Rapporteringsgränsen kan påverkas vid t.ex. spädning p.g.a. matrisstörningar, begränsad provmängd eller låg torrsubstanshalt.

MU = Mätosäkerhet

***** = Asterisk efter resultatet visar på ej ackrediterat test, gäller både egna lab och underleverantör

Mätosäkerhet:

Mätosäkerheten anges som en utvidgad osäkerhet (enligt definitionen i "Evaluation of measurement data- Guide to the expression of uncertainty in measurement", JCGM 100:2008 Corrected version 2010) beräknad med täckningsfaktor lika med 2 vilket ger en konfidensnivå på ungefär 95%.
Mätosäkerhet anges endast för detekterade ämnen med halter över rapporteringsgränsen.

Mätosäkerhet från underleverantör anges oftast som en utvidgad osäkerhet beräknad med täckningsfaktor 2. För ytterligare information kontakta laboratoriet.

Utförande laboratorium (teknisk enhet inom ALS Scandinavia eller anlitat laboratorium (underleverantör)).

	Utf.
CS	*Analys utförd av* ALS Czech Republic s.r.o Česká Lípa, Bendlova 1687/7 Česká Lípa Tjeckien 470 01 Ackrediterad av: CAI Ackrediteringsnummer: 1163
PR	*Analys utförd av* ALS Czech Republic s.r.o Prag, Na Harfe 336/9 Prag Tjeckien 190 00 Ackrediterad av: CAI Ackrediteringsnummer: 1163

Analyscertifikat

Ordernummer	: **LE2101398**	Sida	: 1 av 12
Kund	: **Chalmers Tekniska Högskola**	Projekt	: Länsvatten
Kontaktperson	: Ida-Maja Hassellöv	Beställningsnummer	: 303032, 30IDHAS1
Adress	: Hörselgången 4 412 96 Göteborg Sverige	Provtagare Provtagningspunkt Ankomstdatum, prover	: ---- : ---- : 2021-03-10 13:33
E-post	: ida-maja@chalmers.se	Analys påbörjad	: 2021-03-11
Telefon	: ----	Utfärdad	: 2021-03-17 13:51
C-O-C-nummer (eller Orderblankett-nummer)	: ----	Antal ankomna prover	: 19
Offertnummer	: ST2021SE-CHA-TEK0001 (OF210027)	Antal analyserade prover	: 19

Generell kommentar

Denna rapport får endast återges i sin helhet, om inte utfärdande laboratorium i förväg skriftligen godkänt annat. Laboratoriet tar inget ansvar för information i denna rapport som har lämnats av kunden, eller resultat som kan ha påverkats av sådan information. Beträffande laboratoriets ansvar i samband med uppdrag, se vår webbplats www.alsglobal.se

Signatur	*Position*
Ilia Rodushkin	Laboratoriechef

Ackred. nr 2030
Provning
ISO/IEC 17025

Vessel A Bedore OWS

Matris: **VATTEN**

Provbeteckning	**ID. 06**
Laboratoriets provnummer	LE2101398-008
Provtagningsdatum / tid	2021-02-22

Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Metaller och grundämnen							
Al, aluminium	764	± 77	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	2.96	± 0.32	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	65.4	± 6.5	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	201	± 20	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	0.173	± 0.037	µg/L	0.050	V-3a	W-SFMS-5D	LE
Co, kobolt	2.09	± 0.23	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	1.13	± 0.19	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	2.05	± 0.27	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	3.79	± 0.38	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	79.6	± 8.0	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	91.6	± 9.2	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	359	± 36	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	1.68	± 0.40	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	2350	± 235	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	17.8	± 1.8	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	2.20	± 0.23	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	1.48	± 0.15	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	970	± 97	µg/L	2.0	V-3a	W-SFMS-5D	LE

Sida	: 6 av 12
Ordernummer	: LE2101398
Kund	: Chalmers Tekniska Högskola

Vessel A After OWS

Matris: VATTEN	Provbeteckning	ID. 16					
	Laboratoriets provnummer	LE2101398-009					
	Provtagningsdatum / tid	2021-02-22					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Metaller och grundämnen							
Al, aluminium	473	± 48	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	1.86	± 0.22	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	32.9	± 3.3	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	178	± 18	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	<0.05	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Co, kobolt	1.32	± 0.16	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	<0.5	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	<1	----	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	0.238	± 0.024	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	69.6	± 7.0	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	81.9	± 8.2	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	291	± 29	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	3.98	± 0.54	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	2100	± 210	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	12.4	± 1.3	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	<0.2	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	0.340	± 0.047	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	44.6	± 4.6	µg/L	2.0	V-3a	W-SFMS-5D	LE

Vessel B Before OWS

Matris: VATTEN	Provbeteckning	ID. 26					
	Laboratoriets provnummer	LE2101398-010					
	Provtagningsdatum / tid	2021-02-22					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Metaller och grundämnen							
Al, aluminium	462	± 47	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	<0.5	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	33.5	± 3.4	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	141	± 14	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	<0.05	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Co, kobolt	1.14	± 0.15	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	1.16	± 0.19	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	<1	----	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	2.66	± 0.27	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	56.7	± 5.7	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	73.5	± 7.4	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	787	± 79	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	1.27	± 0.38	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	4660	± 466	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	60.6	± 6.1	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	1.78	± 0.20	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	5.36	± 0.54	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	529	± 53	µg/L	2.0	V-3a	W-SFMS-5D	LE

Vessel B After OWS

Matris: **VATTEN**

	Provbeteckning	ID. 36
	Laboratoriets provnummer	LE2101398-011
	Provtagningsdatum / tid	2021-02-22

Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Metaller och grundämnen							
Al, aluminium	742	± 74	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	0.519	± 0.126	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	31.5	± 3.2	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	139	± 14	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	<0.05	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Co, kobolt	0.943	± 0.136	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	<0.5	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	1.50	± 0.24	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	0.566	± 0.057	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	55.7	± 5.6	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	72.3	± 7.2	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	771	± 77	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	5.03	± 0.62	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	4550	± 455	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	28.4	± 2.9	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	2.14	± 0.23	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	1.98	± 0.20	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	382	± 38	µg/L	2.0	V-3a	W-SFMS-5D	LE

Vessel C Before OWS

Matris: **VATTEN**

	Provbeteckning	ID. 46
	Laboratoriets provnummer	LE2101398-012
	Provtagningsdatum / tid	2021-02-22

Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Metaller och grundämnen							
Al, aluminium	606	± 61	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	<0.5	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	49.6	± 5.0	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	96.9	± 9.7	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	0.115	± 0.035	µg/L	0.050	V-3a	W-SFMS-5D	LE
Co, kobolt	3.68	± 0.38	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	5.03	± 0.53	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	11.1	± 1.1	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	2.26	± 0.23	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	86.9	± 8.7	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	21.1	± 2.1	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	85.5	± 8.6	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	2.23	± 0.43	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	279	± 28	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	9.17	± 0.97	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	4.34	± 0.44	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	4.79	± 0.48	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	239	± 24	µg/L	2.0	V-3a	W-SFMS-5D	LE

Vesse C After OWS

Matris: VATTEN	Provbeteckning	ID. 56					
	Laboratoriets provnummer	LE2101398-013					
	Provtagningsdatum / tid	2021-02-22					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Metaller och grundämnen							
Al, aluminium	178	± 19	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	0.560	± 0.128	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	72.2	± 7.2	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	72.4	± 7.2	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	<0.05	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Co, kobolt	7.02	± 0.71	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	4.28	± 0.46	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	2.51	± 0.31	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	3.49	± 0.35	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	113	± 11	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	16.6	± 1.7	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	137	± 14	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	4.18	± 0.55	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	216	± 22	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	14.2	± 1.5	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	5.54	± 0.56	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	1.82	± 0.19	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	34.0	± 3.5	µg/L	2.0	V-3a	W-SFMS-5D	LE

Vessel A Before OWS

Matris: VATTEN	Provbeteckning	ID. 07					
	Laboratoriets provnummer	LE2101398-014					
	Provtagningsdatum / tid	2021-02-22					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	1010	± 101	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	45.1	± 4.5	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	68.4	± 6.8	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	198	± 20	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	0.216	± 0.025	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	2.98	± 0.31	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	2.99	± 0.32	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	51.5	± 5.2	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	4.38	± 0.48	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	78.3	± 7.8	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	93.7	± 9.4	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	416	± 42	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	6.34	± 0.64	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	2370	± 237	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	24.8	± 2.5	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	5.88	± 0.59	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	1.85	± 0.19	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	1120	± 138	µg/L	4.0	V-3b	W-SFMS-06	LE

Sida	: 9 av 12
Ordernummer	: LE2101398
Kund	: Chalmers Tekniska Högskola

Vessel A After OWS

Matris: **VATTEN**

Provbeteckning	**ID. 17**
Laboratoriets provnummer	*LE2101398-015*
Provtagningsdatum / tid	*2021-02-22*

Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	588	± 59	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	34.2	± 3.4	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	32.2	± 3.2	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	175	± 18	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	<0.05	----	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	1.72	± 0.19	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	<0.9	----	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	1.84	± 0.25	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	0.279	± 0.031	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	68.2	± 6.8	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	82.8	± 8.3	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	340	± 34	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	4.40	± 0.44	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	2080	± 208	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	15.5	± 1.6	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	<0.5	----	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	0.321	± 0.050	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	55.6	± 7.1	µg/L	4.0	V-3b	W-SFMS-06	LE

Vessel B Before OWS

Matris: **VATTEN**

Provbeteckning	**ID. 27**
Laboratoriets provnummer	*LE2101398-016*
Provtagningsdatum / tid	*2021-02-22*

Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	544	± 54	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	69.6	± 7.0	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	31.5	± 3.2	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	137	± 14	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	0.0974	± 0.0154	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	1.70	± 0.19	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	2.28	± 0.25	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	26.9	± 2.7	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	3.04	± 0.33	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	54.3	± 5.4	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	75.0	± 7.5	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	925	± 93	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	4.02	± 0.41	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	4660	± 466	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	69.6	± 7.0	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	2.16	± 0.22	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	6.09	± 0.61	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	576	± 71	µg/L	4.0	V-3b	W-SFMS-06	LE

Vessel B After OWS

Matris: **VATTEN**

Provbeteckning	ID. 37
Laboratoriets provnummer	LE2101398-017
Provtagningsdatum / tid	2021-02-22

Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	883	± 88	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	63.6	± 6.4	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	28.5	± 2.9	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	137	± 14	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	0.0697	± 0.0138	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	1.50	± 0.17	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	1.52	± 0.19	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	78.9	± 7.9	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	0.659	± 0.072	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	53.6	± 5.4	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	74.3	± 7.4	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	902	± 90	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	3.76	± 0.38	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	4560	± 456	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	36.6	± 3.7	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	3.32	± 0.33	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	1.93	± 0.20	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	449	± 56	µg/L	4.0	V-3b	W-SFMS-06	LE

Vessel C Before OWS

Matris: **VATTEN**

Provbeteckning	ID. 47
Laboratoriets provnummer	LE2101398-018
Provtagningsdatum / tid	2021-02-22

Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	684	± 68	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	7.28	± 0.74	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	51.2	± 5.1	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	92.0	± 9.2	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	0.280	± 0.030	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	4.85	± 0.49	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	7.17	± 0.73	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	50.8	± 5.1	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	2.59	± 0.28	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	85.8	± 8.6	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	21.2	± 2.1	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	99.2	± 9.9	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	5.32	± 0.54	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	283	± 28	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	14.3	± 1.4	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	5.52	± 0.55	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	6.20	± 0.62	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	318	± 39	µg/L	4.0	V-3b	W-SFMS-06	LE

Vessel C After OWS

Matris: **VATTEN**		*Provbeteckning*	**ID. 57**					
		Laboratoriets provnummer	*LE2101398-019*					
		Provtagningsdatum / tid	*2021-02-22*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*	
Provberedning								
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE	
Metaller och grundämnen								
Al, aluminium	282	± 28	µg/L	10.0	V-3b	W-SFMS-06	LE	
As, arsenik	8.11	± 0.82	µg/L	0.50	V-3b	W-SFMS-06	LE	
Ba, barium	326	± 33	µg/L	1.00	V-3b	W-SFMS-06	LE	
Ca, kalcium	70.6	± 7.1	mg/L	0.2	V-3b	W-AES-02	LE	
Cd, kadmium	<0.05	----	µg/L	0.050	V-3b	W-SFMS-06	LE	
Co, kobolt	12.4	± 1.2	µg/L	0.20	V-3b	W-SFMS-06	LE	
Cr, krom	6.21	± 0.63	µg/L	0.90	V-3b	W-SFMS-06	LE	
Cu, koppar	142	± 14	µg/L	1.00	V-3b	W-SFMS-06	LE	
Fe, järn	5.99	± 0.66	mg/L	0.0100	V-3b	W-SFMS-06	LE	
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE	
K, kalium	117	± 12	mg/L	0.4	V-3b	W-AES-02	LE	
Mg, magnesium	17.3	± 1.7	mg/L	0.2	V-3b	W-AES-02	LE	
Mn, mangan	2950	± 295	µg/L	0.90	V-3b	W-SFMS-06	LE	
Mo, molybden	8.66	± 0.87	µg/L	0.50	V-3b	W-SFMS-06	LE	
Na, natrium	217	± 22	mg/L	0.5	V-3b	W-AES-02	LE	
Ni, nickel	23.5	± 2.4	µg/L	0.60	V-3b	W-SFMS-06	LE	
Pb, bly	4.82	± 0.48	µg/L	0.50	V-3b	W-SFMS-06	LE	
V, vanadin	3.56	± 0.36	µg/L	0.20	V-3b	W-SFMS-06	LE	
Zn, zink	52.4	± 6.7	µg/L	4.0	V-3b	W-SFMS-06	LE	

Metodsammanfattningar

Analysmetoder	*Metod*
W-AES-02	Analys av metaller i förorenat vatten med ICP-AES enligt SS-EN ISO 11885:2009 och US EPA Metod 200.7:1994 efter uppslutning av prov enligt W-PV-AC.
W-AES-1B	Analys av metaller i förorenat vatten med ICP-AES enligt SS-EN ISO 11885:2009 och US EPA Method 200.7:1994. Analys utan föregående uppslutning. Provet är surgjort med 1 ml HNO3 (suprapur) per 100 ml före analys. Detta gäller ej prov som varit surgjort vid ankomst till laboratoriet.
W-AFS-17V3a	Analys av kvicksilver (Hg) i förorenat vatten med AFS enligt SS-EN ISO 17852:2008. Analys utan föregående uppslutning. Provet är surgjort med 1 ml HNO3 (suprapur) per 100 ml före analys.
W-AFS-17V3b	Analys av kvicksilver (Hg) i förorenat vatten med AFS enligt SS-EN ISO 17852:2008 efter uppslutning av prov enligt W-PV-AC.
W-PV-AC	Upplösning med salpetersyra i autoklav enligt SS 28150:1993 (SE-SOP-0400).
W-SFMS-06	Analys av metaller i förorenat vatten med ICP-SFMS enligt SS-EN ISO 17294-2:2016 och US EPA Metod 200.8:1994 efter uppslutning av prov enligt W-PV-AC.
W-SFMS-5D	Analys av metaller i förorenat vatten med ICP-SFMS enligt SS-EN ISO 17294-2:2016 och US EPA Method 200.8:1994. Analys utan föregående uppslutning. Provet är surgjort med 1 ml HNO3 (suprapur) per 100 ml före analys. Detta gäller ej prov som varit surgjort vid ankomst till laboratoriet.

Nyckel: **LOR** = Den rapporteringsgräns (LOR) som anges är standard för respektive parameter i metoden. Rapporteringsgränsen kan påverkas vid t.ex. spädning p.g.a. matrisstörningar, begränsad provmängd eller låg torrsubstanshalt.

MU = Mätosäkerhet

***** = Asterisk efter resultatet visar på ej ackrediterat test, gäller både egna lab och underleverantör

Mätosäkerhet:

Mätosäkerheten anges som en utvidgad osäkerhet (enligt definitionen i "Evaluation of measurement data- Guide to the expression of uncertainty in measurement", JCGM 100:2008 Corrected version 2010) beräknad med täckningsfaktor lika med 2 vilket ger en konfidensnivå på ungefär 95%.
Mätosäkerhet anges endast för detekterade ämnen med halter över rapporteringsgränsen.

Mätosäkerhet från underleverantör anges oftast som en utvidgad osäkerhet beräknad med täckningsfaktor 2. För ytterligare information kontakta laboratoriet.

Utförande laboratorium (teknisk enhet inom ALS Scandinavia eller anlitat laboratorium (underleverantör)).

	Utf.
LE	*Analys utförd av* ALS Scandinavia AB, Aurorum 10 Luleå Sverige 977 75 Ackrediterad av: SWEDAC Ackrediteringsnummer: 2030

Analysresultat

Matris: **HAVSVATTEN**

Provbeteckning	**61 Vessel D Before OWS**						
Laboratoriets provnummer	*ST2107353-001*						
Provtagningsdatum / tid	*2021-03-28*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	111	± 33.4	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	*	----	µg/L	0.01	OV-1	W-PAHGMS05	PR
acenaften	*	----	µg/L	0.01	OV-1	W-PAHGMS05	PR
fluoren	*	----	µg/L	0.01	OV-1	W-PAHGMS05	PR
fenantren	529	± 159	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	32.4	± 9.73	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	20.8	± 6.25	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	142	± 42.5	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	3.99	± 1.20	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	22.5	± 6.74	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	2.67	± 0.800	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	0.361	± 0.108	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	1.34	± 0.403	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.490	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<3.84	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<1.17	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	*	----	µg/L	0.095	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	30.9	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	*	----	µg/L	0.06	OV-1	W-PAHGMS05	PR
summa PAH L	*	----	µg/L	0.03	OV-1	W-PAHGMS05	PR
summa PAH M	*	----	µg/L	0.03	OV-1	W-PAHGMS05	PR
summa PAH H	30.9	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Analysresultat

Matris: **HAVSVATTEN**

Provbeteckning	**61 Vessel D Before OWS**						
Laboratoriets provnummer	*ST2107353-001*						
Provtagningsdatum / tid	*2021-03-28*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	111	± 33.4	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	*	----	µg/L	0.01	OV-1	W-PAHGMS05	PR
acenaften	*	----	µg/L	0.01	OV-1	W-PAHGMS05	PR
fluoren	*	----	µg/L	0.01	OV-1	W-PAHGMS05	PR
fenantren	529	± 159	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	32.4	± 9.73	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	20.8	± 6.25	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	142	± 42.5	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	3.99	± 1.20	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	22.5	± 6.74	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	2.67	± 0.800	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	0.361	± 0.108	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	1.34	± 0.403	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.490	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<3.84	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<1.17	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	*	----	µg/L	0.095	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	30.9	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	*	----	µg/L	0.06	OV-1	W-PAHGMS05	PR
summa PAH L	*	----	µg/L	0.03	OV-1	W-PAHGMS05	PR
summa PAH M	*	----	µg/L	0.03	OV-1	W-PAHGMS05	PR
summa PAH H	30.9	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning	71 Vessel D After OWS					
	Laboratoriets provnummer	ST2107353-002					
	Provtagningsdatum / tid	2021-03-28					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Polycykliska aromatiska kolväten (PAH)							
naftalen	0.049	± 0.015	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	<0.020	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	<0.020	----	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	0.0490	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	0.049	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	0.0490	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning	81 Vessel E Before OWS					
	Laboratoriets provnummer	ST2107353-003					
	Provtagningsdatum / tid	2021-03-28					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Polycykliska aromatiska kolväten (PAH)							
naftalen	2.24	± 0.671	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	0.040	± 0.012	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	0.543	± 0.163	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	0.644	± 0.193	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	0.632	± 0.190	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	0.020	± 0.006	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.087	± 0.026	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	0.478	± 0.144	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	0.046	± 0.014	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	0.045	± 0.013	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	0.031	± 0.009	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	0.0186	± 0.0056	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	0.059	± 0.018	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	0.020	± 0.006	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	4.90	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	0.161	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	4.74	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	2.82	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	1.86	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	0.220	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning	**91 Vessel E After OWS**					
	Laboratoriets provnummer	*ST2107353-004*					
	Provtagningsdatum / tid	*2021-03-28*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	<0.080	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	<0.020	----	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	<0.130	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	<0.095	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	<0.0600	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning	1001 Vessel F Before OWS					
	Laboratoriets provnummer	ST2107353-005					
	Provtagningsdatum / tid	2021-03-28					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Polycykliska aromatiska kolväten (PAH)							
naftalen	<0.330	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	<0.200	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	1.58	± 0.475	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	6.22	± 1.87	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	5.70	± 1.71	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.390	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.297	± 0.089	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	2.18	± 0.655	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	0.171	± 0.051	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	0.217	± 0.065	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	0.058	± 0.017	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	0.0930	± 0.0279	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	0.021	± 0.006	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	0.127	± 0.038	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	16.7	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	0.560	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	16.1	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	1.58	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	14.4	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	0.687	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**	*Provbeteckning*	**1011 Vessel F After OWS**					
	Laboratoriets provnummer	*ST2107353-006*					
	Provtagningsdatum / tid	*2021-03-28*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	<0.120	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	<0.020	----	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	0.316	± 0.095	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	0.316	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	0.316	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	<0.0800	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	0.316	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**	Provbeteckning	**1021 Vessel G Before OWS**					
	Laboratoriets provnummer	ST2107353-007					
	Provtagningsdatum / tid	2021-03-28					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Polycykliska aromatiska kolväten (PAH)							
naftalen	7.34	± 2.20	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	0.118	± 0.036	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	0.758	± 0.228	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	2.01	± 0.603	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	2.36	± 0.709	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	0.247	± 0.074	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.158	± 0.048	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	1.08	± 0.323	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	0.125	± 0.038	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	0.125	± 0.038	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	0.049	± 0.015	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	0.0495	± 0.0148	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	0.117	± 0.035	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	0.018	± 0.005	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	14.6	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	0.366	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	14.2	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	8.22	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	5.86	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	0.484	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**								
Provbeteckning	**1031 Vessel G After OWS**							
Laboratoriets provnummer	*ST2107353-008*							
Provtagningsdatum / tid	*2021-03-28*							
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	<0.020	----	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	<0.0950	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	<0.060	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	<0.0250	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**							
Provbeteckning	**62 Vessel D Before OWS**						
Laboratoriets provnummer	*ST2107353-009*						
Provtagningsdatum / tid	*2021-03-28*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	134000	± 40000	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	1750	± 524	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	11500	± 3440	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	98700	± 29600	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	21600	± 6480	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**							
Provbeteckning	**72 Vessel D After OWS**						
Laboratoriets provnummer	*ST2107353-010*						
Provtagningsdatum / tid	*2021-03-28*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	<50.0	----	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	<30.0	----	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	<10.0	----	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**82 Vessel E Before OWS**				
	Laboratoriets provnummer		*ST2107353-011*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	12000	± 3590	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	467	± 140	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	1030	± 309	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	7570	± 2270	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	2910	± 874	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**92 Vessel E After OWS**				
	Laboratoriets provnummer		*ST2107353-012*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	<50.0	----	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	<30.0	----	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	<10.0	----	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**1002 Vessel F Before OWS**				
	Laboratoriets provnummer		*ST2107353-013*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	8930	± 2680	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	330	± 99.0	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	1220	± 365	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	6200	± 1860	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	1180	± 355	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**1012 Vessel F After OWS**				
	Laboratoriets provnummer		*ST2107353-014*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	327	± 98.1	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	10.3	± 3.1	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	36.3	± 10.9	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	237	± 71.0	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	43.6	± 13.1	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

Provbeteckning	1022 Vessel G Before OWS						
Laboratoriets provnummer	ST2107353-015						
Provtagningsdatum / tid	2021-03-28						
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Petroleumkolväten							
oljeindex, fraktion C10 - C40	35700	± 10700	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	386	± 116	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	1440	± 431	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	24700	± 7410	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	9150	± 2740	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

Provbeteckning	1032 Vessel G After OWS						
Laboratoriets provnummer	ST2107353-016						
Provtagningsdatum / tid	2021-03-28						
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Petroleumkolväten							
oljeindex, fraktion C10 - C40	799	± 240	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	16.1	± 4.8	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	731	± 219	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	50.7	± 15.2	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

Provbeteckning	63 Vessel D Before OWS						
Laboratoriets provnummer	ST2107353-017						
Provtagningsdatum / tid	2021-03-28						
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
anjoniska tensider	8.10	± 1.62	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**

Provbeteckning	73 Vessel D After OWS						
Laboratoriets provnummer	ST2107353-018						
Provtagningsdatum / tid	2021-03-28						
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
anjoniska tensider	3.07	± 0.614	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**

Provbeteckning	83 Vessel E Before OWS						
Laboratoriets provnummer	ST2107353-019						
Provtagningsdatum / tid	2021-03-28						
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
anjoniska tensider	1.40	± 0.280	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	Provbeteckning	**93 Vessel E After OWS**					
	Laboratoriets provnummer	ST2107353-020					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
anjoniska tensider	0.518	± 0.104	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	Provbeteckning	**1003 Vessel F Before OWS**					
	Laboratoriets provnummer	ST2107353-021					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
anjoniska tensider	1.02	± 0.204	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	Provbeteckning	**1013 Vessel F After OWS**					
	Laboratoriets provnummer	ST2107353-022					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
anjoniska tensider	0.660	± 0.133	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	Provbeteckning	**1023 Vessel G Before OWS**					
	Laboratoriets provnummer	ST2107353-023					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
anjoniska tensider	5.65	± 1.13	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	Provbeteckning	**1033 Vessel G After OWS**					
	Laboratoriets provnummer	ST2107353-024					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
anjoniska tensider	0.964	± 0.193	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**64 Vessel D Before OWS**				
	Laboratoriets provnummer		*ST2107353-025*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	5.41 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**74 Vessel D After OWS**				
	Laboratoriets provnummer		*ST2107353-026*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**84 Vessel E Before OWS**				
	Laboratoriets provnummer		*ST2107353-027*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	0.80 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**94 Vessel E After OWS**				
	Laboratoriets provnummer		*ST2107353-028*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**1004 Vessel F Before OWS**				
	Laboratoriets provnummer		*ST2107353-029*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	0.48 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning		**1014 Vessel F After OWS**					
Laboratoriets provnummer		ST2107353-030					
Provtagningsdatum / tid		2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning		**1024 Vessel G Before OWS**					
Laboratoriets provnummer		ST2107353-031					
Provtagningsdatum / tid		2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	0.49 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning		**1034 Vessel G After OWS**					
Laboratoriets provnummer		ST2107353-032					
Provtagningsdatum / tid		2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning		**65 Vessel D Before OWS**					
Laboratoriets provnummer		ST2107353-033					
Provtagningsdatum / tid		2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	0.50	± 0.17	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning		**75 Vessel D After OWS**					
Laboratoriets provnummer		ST2107353-034					
Provtagningsdatum / tid		2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	<0.20	----	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*	**85 Vessel E Before OWS**					
	Laboratoriets provnummer	ST2107353-035					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	8.69	± 1.74	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*	**95 Vessel E After OWS**					
	Laboratoriets provnummer	ST2107353-036					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	4.66	± 0.94	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*	**1005 Vessel F Before OWS**					
	Laboratoriets provnummer	ST2107353-037					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	0.34	± 0.15	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*	**1015 Vessel F After OWS**					
	Laboratoriets provnummer	ST2107353-038					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	0.31	± 0.15	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*	**1025 Vessel G Before OWS**					
	Laboratoriets provnummer	ST2107353-039					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	1.61	± 0.35	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	Provbeteckning		**1035 Vessel G After OWS**					
	Laboratoriets provnummer		ST2107353-040					
	Provtagningsdatum / tid		2021-03-28					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
nonjoniska tensider	0.29	± 0.14	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Metodsammanfattningar

Analysmetoder	Metod
W-SURA-CFA	Spektrofotomtrisk bestämning av anjoniska tensider genom mätning av metylenblått index (MBAS) enligt metod CSN ISO 16265, SKALAR och CSN EN 903.
W-SURC-PHO*	Bestämning av katjoniska tensider med bromfenolblå (BAC) enligt intern metod.
W-SURN2-PHO	Bestämning av nonjoniska tensider (BiAS) spektrofotometriskt med en HACH kyvett enligt intern metod.
W-PAHGMS05	Bestämning av polycykliska aromatiska kolväten, PAH (16 föreningar enligt EPA), enligt metod baserad på US EPA 8270D, US EPA 8082A, CSN EN ISO 6468 och US EPA 8000D. Mätning utförs med GC-MS eller GC-MS/MS. PAH cancerogena utgörs av bens(a)antracen, krysen, bens(b)fluoranten, bens(k)fluoranten, bens(a)pyren, dibens(ah)antracen och indeno(123cd)pyren. Bestämning av polycykliska aromatiska kolväten; summa PAH L, summa PAH M och summa PAH H. Summa PAH L: naftalen, acenaften och acenaftylen. Summa PAH M: fluoren, fenantren, antracen, fluoranten och pyren. Summa PAH H: bens(a)antracen, krysen, bens(b)fluoranten, bens(k)fluoranten, bens(a)pyren, indeno(1,2,3-c,d)pyren, dibens(a,h)antracen och bens(g,h,i)perylen). PAH summorna är definerade enligt direktiv från Naturvårdsverket utgivna i oktober 2008.
W-TPHFID01	Bestämning av oljeindex enligt metod CSN EN ISO 9377-2, US EPA 8015, US EPA 3510, TNRCC Metod 1006. Mätning utförs med GC-FID.

Nyckel: **LOR** = Den rapporteringsgräns (LOR) som anges är standard för respektive parameter i metoden. Rapporteringsgränsen kan påverkas vid t.ex. spädning p.g.a. matrisstörningar, begränsad provmängd eller låg torrsubstanshalt.

MU = Mätosäkerhet

***** = Asterisk efter resultatet visar på ej ackrediterat test, gäller både egna lab och underleverantör

Mätosäkerhet:

Mätosäkerheten anges som en utvidgad osäkerhet (enligt definitionen i "Evaluation of measurement data- Guide to the expression of uncertainty in measurement", JCGM 100:2008 Corrected version 2010) beräknad med täckningsfaktor lika med 2 vilket ger en konfidensnivå på ungefär 95%.
Mätosäkerhet anges endast för detekterade ämnen med halter över rapporteringsgränsen.

Mätosäkerhet från underleverantör anges oftast som en utvidgad osäkerhet beräknad med täckningsfaktor 2. För ytterligare information kontakta laboratoriet.

Utförande laboratorium (teknisk enhet inom ALS Scandinavia eller anlitat laboratorium (underleverantör)).

	Utf.
CS	*Analys utförd av* ALS Czech Republic s.r.o Česká Lípa, Bendlova 1687/7 Česká Lípa Tjeckien 470 01 Ackrediterad av: CAI Ackrediteringsnummer: 1163
PR	*Analys utförd av* ALS Czech Republic s.r.o Prag, Na Harfe 336/9 Prag Tjeckien 190 00 Ackrediterad av: CAI Ackrediteringsnummer: 1163

Analyscertifikat

Ordernummer	:	**LE2101922**	Sida	:	1 av 17
Kund	:	**Chalmers Tekniska Högskola**	Projekt	:	----
Kontaktperson	:	Ida-Maja Hassellöv	Beställningsnummer	:	----
Adress	:	Hörselgången 4	Provtagare	:	----
		412 96 Göteborg	Provtagningspunkt	:	----
		Sverige	Ankomstdatum, prover	:	2021-03-29 22:35
E-post	:	ida-maja@chalmers.se	Analys påbörjad	:	2021-03-31
Telefon	:	----	Utfärdad	:	2021-04-08 13:00
C-O-C-nummer (eller Orderblankett-nummer)	:	----	Antal ankomna prover	:	22
Offertnummer	:	ST2021SE-CHA-TEK0001 (OF210027)	Antal analyserade prover	:	22

Generell kommentar

Denna rapport får endast återges i sin helhet, om inte utfärdande laboratorium i förväg skriftligen godkänt annat. Laboratoriet tar inget ansvar för information i denna rapport som har lämnats av kunden, eller resultat som kan ha påverkats av sådan information. Beträffande laboratoriets ansvar i samband med uppdrag, se vår webbplats www.alsglobal.se

Signatur	*Position*
Ilia Rodushkin	Laboratoriechef

Ackred. nr 2030
Provning
ISO/IEC 17025

Matris: **HAVSVATTEN**	Provbeteckning	66 D Before OWS					
	Laboratoriets provnummer	LE2101922-007					
	Provtagningsdatum / tid	2021-03-31					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Metaller och grundämnen							
Al, aluminium	39900 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	2.66 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	82.1 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	171	± 17	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	3.39 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Co, kobolt	21.1 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	25.6 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	10.2 *	----	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	9.53 *	----	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	0.0587	± 0.0190	µg/L	0.020	V-3a	W-AFS-17V3a	LE
K, kalium	52.8	± 5.3	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	52.4	± 5.2	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	200 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	1.74 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	746	± 75	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	197 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	74.1 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	42.5 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	3700 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE

Matris: **HAVSVATTEN**

Provbeteckning		76 **D After OWS**					
Laboratoriets provnummer		LE2101922-008					
Provtagningsdatum / tid		2021-03-31					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Metaller och grundämnen							
Al, aluminium	24.3 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	0.897 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	25.8 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	88.7	± 8.9	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	<0.05 *	----	µg/L	0.05	V-3a	W-SFMS-5D	LE
Co, kobolt	0.0617 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	<0.5 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	<1 *	----	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	0.0688 *	----	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	37.8	± 3.8	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	36.7	± 3.7	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	53.9 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	0.968 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	724	± 72	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	13.3 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	<0.2 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	1.32 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	<2 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE

Matris: **HAVSVATTEN**

Provbeteckning		86 **E Before OWS**					
Laboratoriets provnummer		LE2101922-009					
Provtagningsdatum / tid		2021-03-31					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Metaller och grundämnen							
Al, aluminium	1350 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	0.567 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	87.6 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	63.4	± 6.3	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	0.603 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Co, kobolt	7.41 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	20.0 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	15.4 *	----	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	1.90 *	----	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	18.5	± 1.9	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	29.2	± 2.9	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	162 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	15.3 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	479	± 48	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	22.4 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	15.0 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	7.46 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	818 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE

Matris: **HAVSVATTEN**	*Provbeteckning*	**96 E After OWS**					
	Laboratoriets provnummer	*LE2101922-010*					
	Provtagningsdatum / tid	*2021-03-31*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Metaller och grundämnen							
Al, aluminium	1980 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	2.66 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	34.3 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	51.2	± 5.1	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	<0.05 *	----	µg/L	0.05	V-3a	W-SFMS-5D	LE
Co, kobolt	6.52 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	5.97 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	20.5 *	----	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	0.700 *	----	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	19.0	± 1.9	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	20.3	± 2.0	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	152 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	24.9 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	452	± 45	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	17.6 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	8.62 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	2.76 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	147 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE

Matris: **HAVSVATTEN**	*Provbeteckning*	**1006 F Before OWS**					
	Laboratoriets provnummer	*LE2101922-011*					
	Provtagningsdatum / tid	*2021-03-31*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Metaller och grundämnen							
Al, aluminium	450 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	0.843 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	42.8 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	151	± 15	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	<0.05 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Co, kobolt	23.6 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	3.01 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	60.5 *	----	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	21.2 *	----	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	57.7	± 5.8	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	66.5	± 6.7	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	779 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	12.1 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	725	± 73	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	2080 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	2.70 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	149 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	279 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE

Matris: **HAVSVATTEN**

Provbeteckning	**1016 F After OWS**
Laboratoriets provnummer	*LE2101922-012*
Provtagningsdatum / tid	*2021-03-31*

Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Metaller och grundämnen							
Al, aluminium	2850 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	0.638 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	36.9 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	153	± 15	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	<0.05 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Co, kobolt	19.5 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	0.787 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	8.43 *	----	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	8.58 *	----	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	57.9	± 5.8	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	67.4	± 6.7	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	750 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	10.3 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	716	± 72	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	1900 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	1.30 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	48.5 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	53.0 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE

Matris: **HAVSVATTEN**

Provbeteckning	**1026 G Before OWS**
Laboratoriets provnummer	*LE2101922-013*
Provtagningsdatum / tid	*2021-03-31*

Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Metaller och grundämnen							
Al, aluminium	414 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	3.50 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	19.9 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	33.3	± 3.3	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	<0.07 *	----	µg/L	0.05	V-3a	W-SFMS-5D	LE
Co, kobolt	5.65 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	3.69 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	3.34 *	----	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	3.41 *	----	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	16.5	± 1.7	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	29.1	± 2.9	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	111 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	135 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	360	± 36	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	40.1 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	1.40 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	14.6 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	1660 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE

Matris: **HAVSVATTEN**	*Provbeteckning*			**1036 G After OWS**			
	Laboratoriets provnummer			*LE2101922-014*			
	Provtagningsdatum / tid			*2021-03-31*			
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Metaller och grundämnen							
Al, aluminium	166 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE
As, arsenik	2.56 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Ba, barium	32.1 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Ca, kalcium	49.6	± 5.0	mg/L	0.2	V-3a	W-AES-1B	LE
Cd, kadmium	<0.05 *	----	µg/L	0.05	V-3a	W-SFMS-5D	LE
Co, kobolt	5.02 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Cr, krom	0.550 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Cu, koppar	20.9 *	----	µg/L	1.0	V-3a	W-SFMS-5D	LE
Fe, järn	1.93 *	----	mg/L	0.00400	V-3a	W-SFMS-5D	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3a	W-AFS-17V3a	LE
K, kalium	13.8	± 1.4	mg/L	0.5	V-3a	W-AES-1B	LE
Mg, magnesium	32.4	± 3.2	mg/L	0.09	V-3a	W-AES-1B	LE
Mn, mangan	139 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
Mo, molybden	48.5 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Na, natrium	322	± 32	mg/L	0.2	V-3a	W-AES-1B	LE
Ni, nickel	25.2 *	----	µg/L	0.50	V-3a	W-SFMS-5D	LE
Pb, bly	5.64 *	----	µg/L	0.20	V-3a	W-SFMS-5D	LE
V, vanadin	2.27 *	----	µg/L	0.050	V-3a	W-SFMS-5D	LE
Zn, zink	155 *	----	µg/L	2.0	V-3a	W-SFMS-5D	LE

Matris: **HAVSVATTEN**	*Provbeteckning*			**67 D Before OWS**			
	Laboratoriets provnummer			*LE2101922-015*			
	Provtagningsdatum / tid			*2021-03-31*			
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	44300	± 4430	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	7.56	± 0.77	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	106	± 11	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	121	± 12	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	5.68	± 0.57	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	39.3	± 3.9	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	37.8	± 3.8	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	652	± 65	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	11.7	± 1.3	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	0.0950	± 0.0176	µg/L	0.020	V-3b	W-AFS-17V3b	LE
K, kalium	39.6	± 4.0	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	42.5	± 4.3	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	217	± 22	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	18.0	± 1.8	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	733	± 73	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	313	± 31	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	74.4	± 7.4	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	46.6	± 4.7	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	4340	± 536	µg/L	4.0	V-3b	W-SFMS-06	LE

Matris: **HAVSVATTEN**

Provbeteckning	77 **D After OWS**						
Laboratoriets provnummer	*LE2101922-016*						
Provtagningsdatum / tid	*2021-03-31*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	19.1	± 2.6	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	2.19	± 0.25	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	27.4	± 2.7	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	86.7	± 8.7	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	<0.05	----	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	0.351	± 0.088	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	<0.9	----	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	<1	----	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	0.0875	± 0.0097	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	37.8	± 3.8	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	40.2	± 4.0	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	56.2	± 5.6	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	2.48	± 0.26	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	695	± 70	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	16.2	± 1.6	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	<0.5	----	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	1.31	± 0.14	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	<4	----	µg/L	4.0	V-3b	W-SFMS-06	LE

Matris: **HAVSVATTEN**	Provbeteckning	87 **E Before OWS**					
	Laboratoriets provnummer	LE2101922-017					
	Provtagningsdatum / tid	2021-03-31					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	1410	± 141	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	1.34	± 0.18	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	86.2	± 8.6	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	60.7	± 6.1	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	0.802	± 0.081	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	10.7	± 1.1	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	23.8	± 2.4	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	48.1	± 4.8	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	2.24	± 0.25	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	18.0	± 1.8	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	30.6	± 3.1	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	169	± 17	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	36.2	± 3.6	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	455	± 46	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	24.4	± 2.4	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	16.1	± 1.6	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	7.62	± 0.76	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	901	± 111	µg/L	4.0	V-3b	W-SFMS-06	LE

Matris: **HAVSVATTEN**

Provbeteckning	**97 E After OWS**						
Laboratoriets provnummer	*LE2101922-018*						
Provtagningsdatum / tid	*2021-03-31*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	1980	± 198	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	2.50	± 0.28	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	35.1	± 3.5	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	50.6	± 5.1	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	0.0937	± 0.0152	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	6.77	± 0.68	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	6.44	± 0.65	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	57.2	± 5.7	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	0.753	± 0.083	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	19.8	± 2.0	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	22.5	± 2.3	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	164	± 17	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	26.6	± 2.7	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	441	± 44	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	17.6	± 1.8	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	8.87	± 0.89	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	2.90	± 0.29	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	154	± 19	µg/L	4.0	V-3b	W-SFMS-06	LE

Matris: **HAVSVATTEN**	*Provbeteckning*	**1007 F Before OWS**					
	Laboratoriets provnummer	*LE2101922-019*					
	Provtagningsdatum / tid	*2021-03-31*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	398	± 40	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	0.667	± 0.142	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	44.2	± 4.4	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	153	± 15	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	0.0628	± 0.0135	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	25.5	± 2.6	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	35.1	± 3.5	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	48.8	± 4.9	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	17.7	± 1.9	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	59.0	± 5.9	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	74.1	± 7.4	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	920	± 92	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	19.1	± 1.9	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	705	± 71	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	2260	± 226	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	3.76	± 0.38	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	120	± 12	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	393	± 49	µg/L	4.0	V-3b	W-SFMS-06	LE

Matris: **HAVSVATTEN**	Provbeteckning	1017 F After OWS					
	Laboratoriets provnummer	LE2101922-020					
	Provtagningsdatum / tid	2021-03-31					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	2450	± 245	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	1.08	± 0.17	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	37.5	± 3.8	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	149	± 15	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	0.0525	± 0.0130	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	20.7	± 2.1	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	56.7	± 5.7	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	48.4	± 4.8	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	8.66	± 0.95	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	58.7	± 5.9	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	73.1	± 7.3	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	907	± 91	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	20.1	± 2.0	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	712	± 71	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	2030	± 203	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	1.98	± 0.20	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	47.5	± 4.8	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	62.7	± 7.9	µg/L	4.0	V-3b	W-SFMS-06	LE

Matris: **HAVSVATTEN**							
Provbeteckning	**1027 G Before OWS**						
Laboratoriets provnummer	LE2101922-021						
Provtagningsdatum / tid	2021-03-31						
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	428	± 43	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	7.11	± 0.72	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	20.8	± 2.1	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	28.6	± 2.9	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	0.260	± 0.029	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	9.07	± 0.91	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	8.04	± 0.81	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	103	± 10	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	3.85	± 0.42	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	15.0	± 1.5	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	28.3	± 2.8	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	116	± 12	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	266	± 27	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	346	± 35	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	49.0	± 4.9	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	6.70	± 0.67	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	16.1	± 1.6	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	1860	± 230	µg/L	4.0	V-3b	W-SFMS-06	LE

Matris: **HAVSVATTEN**	Provbeteckning	1037 **G After OWS**					
	Laboratoriets provnummer	LE2101922-022					
	Provtagningsdatum / tid	2021-03-31					
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Provberedning							
Uppslutning	Ja	----	-	-	P-HNO3-AC	W-PV-AC	LE
Metaller och grundämnen							
Al, aluminium	175	± 18	µg/L	10.0	V-3b	W-SFMS-06	LE
As, arsenik	3.26	± 0.35	µg/L	0.50	V-3b	W-SFMS-06	LE
Ba, barium	32.7	± 3.3	µg/L	1.00	V-3b	W-SFMS-06	LE
Ca, kalcium	47.5	± 4.8	mg/L	0.2	V-3b	W-AES-02	LE
Cd, kadmium	0.0986	± 0.0155	µg/L	0.050	V-3b	W-SFMS-06	LE
Co, kobolt	5.36	± 0.54	µg/L	0.20	V-3b	W-SFMS-06	LE
Cr, krom	<0.9	----	µg/L	0.90	V-3b	W-SFMS-06	LE
Cu, koppar	66.2	± 6.6	µg/L	1.00	V-3b	W-SFMS-06	LE
Fe, järn	2.11	± 0.23	mg/L	0.0100	V-3b	W-SFMS-06	LE
Hg, kvicksilver	<0.02	----	µg/L	0.02	V-3b	W-AFS-17V3b	LE
K, kalium	13.8	± 1.4	mg/L	0.4	V-3b	W-AES-02	LE
Mg, magnesium	35.0	± 3.5	mg/L	0.2	V-3b	W-AES-02	LE
Mn, mangan	147	± 15	µg/L	0.90	V-3b	W-SFMS-06	LE
Mo, molybden	52.7	± 5.3	µg/L	0.50	V-3b	W-SFMS-06	LE
Na, natrium	320	± 32	mg/L	0.5	V-3b	W-AES-02	LE
Ni, nickel	22.0	± 2.2	µg/L	0.60	V-3b	W-SFMS-06	LE
Pb, bly	5.96	± 0.60	µg/L	0.50	V-3b	W-SFMS-06	LE
V, vanadin	2.03	± 0.21	µg/L	0.20	V-3b	W-SFMS-06	LE
Zn, zink	182	± 23	µg/L	4.0	V-3b	W-SFMS-06	LE

Metodsammanfattningar

Analysmetoder	*Metod*
W-AES-02	Analys av metaller i förorenat vatten med ICP-AES enligt SS-EN ISO 11885:2009 och US EPA Metod 200.7:1994 efter uppslutning av prov enligt W-PV-AC.
W-AES-1B	Analys av metaller i förorenat vatten med ICP-AES enligt SS-EN ISO 11885:2009 och US EPA Method 200.7:1994. Analys utan föregående uppslutning. Provet är surgjort med 1 ml HNO3 (suprapur) per 100 ml före analys.
W-AFS-17V3a	Analys av kvicksilver (Hg) i förorenat vatten med AFS enligt SS-EN ISO 17852:2008. Analys utan föregående uppslutning. Provet är surgjort med 1 ml HNO3 (suprapur) per 100 ml före analys.
W-AFS-17V3b	Analys av kvicksilver (Hg) i förorenat vatten med AFS enligt SS-EN ISO 17852:2008 efter uppslutning av prov enligt W-PV-AC.
W-PV-AC	Upplösning med salpetersyra i autoklav enligt SS 28150:1993 (SE-SOP-0400).
W-SFMS-06	Analys av metaller i förorenat vatten med ICP-SFMS enligt SS-EN ISO 17294-2:2016 och US EPA Metod 200.8:1994 efter uppslutning av prov enligt W-PV-AC.
W-SFMS-5D	Analys av metaller i förorenat vatten med ICP-SFMS enligt SS-EN ISO 17294-2:2016 och US EPA Method 200.8:1994. Analys utan föregående uppslutning. Provet är surgjort med 1 ml HNO3 (suprapur) per 100 ml före analys.

Nyckel: **LOR** = Den rapporteringsgräns (LOR) som anges är standard för respektive parameter i metoden. Rapporteringsgränsen kan påverkas vid t.ex. spädning p.g.a. matrisstörningar, begränsad provmängd eller låg torrsubstanshalt.

MU = Mätosäkerhet

***** = Asterisk efter resultatet visar på ej ackrediterat test, gäller både egna lab och underleverantör

Mätosäkerhet:

Mätosäkerheten anges som en utvidgad osäkerhet (enligt definitionen i "Evaluation of measurement data- Guide to the expression of uncertainty in measurement", JCGM 100:2008 Corrected version 2010) beräknad med täckningsfaktor lika med 2 vilket ger en konfidensnivå på ungefär 95%.
Mätosäkerhet anges endast för detekterade ämnen med halter över rapporteringsgränsen.

Mätosäkerhet från underleverantör anges oftast som en utvidgad osäkerhet beräknad med täckningsfaktor 2. För ytterligare information kontakta laboratoriet.

Utförande laboratorium (teknisk enhet inom ALS Scandinavia eller anlitat laboratorium (underleverantör)).

	Utf.
LE	*Analys utförd av* ALS Scandinavia AB, Aurorum 10 Luleå Sverige 977 75 Ackrediterad av: SWEDAC Ackrediteringsnummer: 2030

Analyscertifikat

Ordernummer	: **ST2107353** (preliminär rapport (CoA))	Sida	: 1 av 16
Kund	: **Chalmers Tekniska Högskola**	Projekt	: ----
Kontaktperson	: Ida-Maja Hassellöv	Beställningsnummer	: ----
Adress	: Hörselgången 4 412 96 Göteborg Sverige	Provtagare	: ----
		Provtagningspunkt	: ----
		Ankomstdatum, prover	: 2021-03-30 07:00
E-post	: ida-maja@chalmers.se	Analys påbörjad	: 2021-04-06
Telefon	: ----	Utfärdad	: 2021-04-15 18:03
C-O-C-nummer (eller Orderblankett-nummer)	: ----	Antal ankomna prover	: 40
Offertnummer	: ST2021SE-CHA-TEK0001 (OF210027)	Antal analyserade prover	: 40

Generell kommentar

Orderkommentar

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Prov ST2107353/001 , W-PAHGMS05 - (*) = Parametrarna som signerats av denna symbol kunde inte bestämmas på grund av komplicerad matris.
Prov ST2107353/009,011,015, metod W-TPHFID01, innehåller en oljefilm, analysen utfördes på vattenfasen.
Prov ST2107353/003, 007, metod W-PAHGMS05, innehåller en oljefilm, analysen utfördes på hela provet.

Signatur	*Position*
Niels-Kristian Terkildsen	Laboratoriechef

Analysresultat

Matris: **HAVSVATTEN**					Provbeteckning	61 **Vessel D Before OWS**		
					Laboratoriets provnummer	ST2107353-001		
					Provtagningsdatum / tid	2021-03-28		
Parameter	Resultat	MU	Enhet	LOR	Analys paket		Metod	Utf.
Polycykliska aromatiska kolväten (PAH)								
naftalen	NAU	----	µg/L	0.030	OV-1		W-PAHGMS05	PR
acenaftylen	NAU	----	µg/L	0.01	OV-1		W-PAHGMS05	PR
acenaften	NAU	----	µg/L	0.01	OV-1		W-PAHGMS05	PR
fluoren	NAU	----	µg/L	0.01	OV-1		W-PAHGMS05	PR
fenantren	NAU	----	µg/L	0.020	OV-1		W-PAHGMS05	PR
antracen	NAU	----	µg/L	0.010	OV-1		W-PAHGMS05	PR
fluoranten	NAU	----	µg/L	0.010	OV-1		W-PAHGMS05	PR
pyren	NAU	----	µg/L	0.010	OV-1		W-PAHGMS05	PR
bens(a)antracen	NAU	----	µg/L	0.010	OV-1		W-PAHGMS05	PR
krysen	NAU	----	µg/L	0.010	OV-1		W-PAHGMS05	PR
bens(b)fluoranten	NAU	----	µg/L	0.010	OV-1		W-PAHGMS05	PR
bens(k)fluoranten	NAU	----	µg/L	0.010	OV-1		W-PAHGMS05	PR
bens(a)pyren	NAU	----	µg/L	0.0100	OV-1		W-PAHGMS05	PR
dibens(a,h)antracen	NAU	----	µg/L	0.010	OV-1		W-PAHGMS05	PR
bens(g,h,i)perylen	NAU	----	µg/L	0.010	OV-1		W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	NAU	----	µg/L	0.010	OV-1		W-PAHGMS05	PR
summa PAH 16	NAU	----	µg/L	0.095	OV-1		W-PAHGMS05	PR
summa cancerogena PAH	NAU	----	µg/L	0.0350	OV-1		W-PAHGMS05	PR
summa övriga PAH	NAU	----	µg/L	0.06	OV-1		W-PAHGMS05	PR
summa PAH L	NAU	----	µg/L	0.03	OV-1		W-PAHGMS05	PR
summa PAH M	NAU	----	µg/L	0.03	OV-1		W-PAHGMS05	PR
summa PAH H	NAU	----	µg/L	0.0400	OV-1		W-PAHGMS05	PR

Matris: **HAVSVATTEN**	*Provbeteckning*	**71 Vessel D After OWS**					
	Laboratoriets provnummer	*ST2107353-002*					
	Provtagningsdatum / tid	*2021-03-28*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	0.049	± 0.015	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	<0.020	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	<0.020	----	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	0.0490	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	0.049	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	0.0490	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning	**81 Vessel E Before OWS**					
	Laboratoriets provnummer	*ST2107353-003*					
	Provtagningsdatum / tid	*2021-03-28*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	2.24	± 0.671	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	0.040	± 0.012	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	0.543	± 0.163	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	0.644	± 0.193	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	0.632	± 0.190	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	0.020	± 0.006	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.087	± 0.026	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	0.478	± 0.144	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	0.046	± 0.014	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	0.045	± 0.013	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	0.031	± 0.009	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	0.0186	± 0.0056	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	0.059	± 0.018	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	0.020	± 0.006	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	4.90	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	0.161	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	4.74	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	2.82	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	1.86	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	0.220	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**	*Provbeteckning*	**91 Vessel E After OWS**					
	Laboratoriets provnummer	*ST2107353-004*					
	Provtagningsdatum / tid	*2021-03-28*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	<0.080	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	<0.020	----	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	<0.130	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	<0.095	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	<0.0600	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

Provbeteckning	**1001 Vessel F Before OWS**						
Laboratoriets provnummer	*ST2107353-005*						
Provtagningsdatum / tid	*2021-03-28*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	<0.330	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	<0.200	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	1.58	± 0.475	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	6.22	± 1.87	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	5.70	± 1.71	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.390	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.297	± 0.089	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	2.18	± 0.655	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	0.171	± 0.051	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	0.217	± 0.065	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	0.058	± 0.017	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	0.0930	± 0.0279	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	0.021	± 0.006	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	0.127	± 0.038	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	16.7	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	0.560	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	16.1	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	1.58	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	14.4	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	0.687	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning	1011 Vessel F After OWS					
	Laboratoriets provnummer	ST2107353-006					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	**MU**	**Enhet**	**LOR**	**Analys paket**	**Metod**	**Utf.**
Polycykliska aromatiska kolväten (PAH)							
naftalen	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	<0.120	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	<0.020	----	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	0.316	± 0.095	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	0.316	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	0.316	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	<0.0800	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	0.316	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**

	Provbeteckning		1021 Vessel G Before OWS				
	Laboratoriets provnummer		ST2107353-007				
	Provtagningsdatum / tid		2021-03-28				
Parameter	**Resultat**	**MU**	**Enhet**	**LOR**	**Analys paket**	**Metod**	**Utf.**
Polycykliska aromatiska kolväten (PAH)							
naftalen	7.34	± 2.20	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	0.118	± 0.036	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	0.758	± 0.228	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	2.01	± 0.603	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	2.36	± 0.709	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	0.247	± 0.074	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	0.158	± 0.048	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	1.08	± 0.323	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	0.125	± 0.038	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	0.125	± 0.038	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	0.049	± 0.015	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	0.0495	± 0.0148	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.015	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	0.117	± 0.035	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	0.018	± 0.005	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	14.6	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	0.366	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	14.2	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	8.22	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	5.86	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	0.484	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**1031 Vessel G After OWS**				
	Laboratoriets provnummer		*ST2107353-008*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Polycykliska aromatiska kolväten (PAH)							
naftalen	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
acenaftylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
acenaften	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fenantren	<0.020	----	µg/L	0.020	OV-1	W-PAHGMS05	PR
antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
krysen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(b)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(k)fluoranten	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(a)pyren	<0.0100	----	µg/L	0.0100	OV-1	W-PAHGMS05	PR
dibens(a,h)antracen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
bens(g,h,i)perylen	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
indeno(1,2,3,cd) pyren	<0.010	----	µg/L	0.010	OV-1	W-PAHGMS05	PR
summa PAH 16	<0.0950	----	µg/L	0.0950	OV-1	W-PAHGMS05	PR
summa cancerogena PAH	<0.0350	----	µg/L	0.0350	OV-1	W-PAHGMS05	PR
summa övriga PAH	<0.060	----	µg/L	0.060	OV-1	W-PAHGMS05	PR
summa PAH L	<0.0250	----	µg/L	0.0300	OV-1	W-PAHGMS05	PR
summa PAH M	<0.030	----	µg/L	0.030	OV-1	W-PAHGMS05	PR
summa PAH H	<0.0400	----	µg/L	0.0400	OV-1	W-PAHGMS05	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**62 Vessel D Before OWS**				
	Laboratoriets provnummer		*ST2107353-009*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	134000	± 40000	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	1750	± 524	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	11500	± 3440	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	98700	± 29600	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	21600	± 6480	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**72 Vessel D After OWS**				
	Laboratoriets provnummer		*ST2107353-010*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	<50.0	----	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	<30.0	----	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	<10.0	----	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**82 Vessel E Before OWS**				
	Laboratoriets provnummer		*ST2107353-011*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	12000	± 3590	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	467	± 140	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	1030	± 309	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	7570	± 2270	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	2910	± 874	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**92 Vessel E After OWS**				
	Laboratoriets provnummer		*ST2107353-012*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	<50.0	----	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	<30.0	----	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	<10.0	----	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**1002 Vessel F Before OWS**				
	Laboratoriets provnummer		*ST2107353-013*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	8930	± 2680	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	330	± 99.0	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	1220	± 365	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	6200	± 1860	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	1180	± 355	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**	*Provbeteckning*		**1012 Vessel F After OWS**				
	Laboratoriets provnummer		*ST2107353-014*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	327	± 98.1	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	10.3	± 3.1	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	36.3	± 10.9	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	237	± 71.0	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	43.6	± 13.1	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

Provbeteckning	1022 Vessel G Before OWS						
Laboratoriets provnummer	ST2107353-015						
Provtagningsdatum / tid	2021-03-28						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	35700	± 10700	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	386	± 116	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	1440	± 431	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	24700	± 7410	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	9150	± 2740	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

Provbeteckning	1032 Vessel G After OWS						
Laboratoriets provnummer	ST2107353-016						
Provtagningsdatum / tid	2021-03-28						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Petroleumkolväten							
oljeindex, fraktion C10 - C40	799	± 240	µg/L	50.0	OV-20C	W-TPHFID01	PR
fraktion C10 - C12	<5.0	----	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C12 - C16	16.1	± 4.8	µg/L	5.0	OV-20C	W-TPHFID01	PR
fraktion C16 - C35	731	± 219	µg/L	30.0	OV-20C	W-TPHFID01	PR
fraktion C35 - C40	50.7	± 15.2	µg/L	10.0	OV-20C	W-TPHFID01	PR

Matris: **HAVSVATTEN**

Provbeteckning	63 Vessel D Before OWS						
Laboratoriets provnummer	ST2107353-017						
Provtagningsdatum / tid	2021-03-28						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	8.10	± 1.62	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**

Provbeteckning	73 Vessel D After OWS						
Laboratoriets provnummer	ST2107353-018						
Provtagningsdatum / tid	2021-03-28						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	3.07	± 0.614	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**

Provbeteckning	83 Vessel E Before OWS						
Laboratoriets provnummer	ST2107353-019						
Provtagningsdatum / tid	2021-03-28						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	1.40	± 0.280	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**93 Vessel E After OWS**				
	Laboratoriets provnummer		*ST2107353-020*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	0.518	± 0.104	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**1003 Vessel F Before OWS**				
	Laboratoriets provnummer		*ST2107353-021*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	1.02	± 0.204	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**1013 Vessel F After OWS**				
	Laboratoriets provnummer		*ST2107353-022*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	0.660	± 0.133	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**1023 Vessel G Before OWS**				
	Laboratoriets provnummer		*ST2107353-023*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	5.65	± 1.13	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**	*Provbeteckning*		**1033 Vessel G After OWS**				
	Laboratoriets provnummer		*ST2107353-024*				
	Provtagningsdatum / tid		*2021-03-28*				
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
anjoniska tensider	0.964	± 0.193	mg/L	0.020	Tensider, anjoniska	W-SURA-CFA	CS

Matris: **HAVSVATTEN**

	Provbeteckning	**64 Vessel D Before OWS**					
	Laboratoriets provnummer	*ST2107353-025*					
	Provtagningsdatum / tid	*2021-03-28*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	5.41 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

	Provbeteckning	**74 Vessel D After OWS**					
	Laboratoriets provnummer	*ST2107353-026*					
	Provtagningsdatum / tid	*2021-03-28*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

	Provbeteckning	**84 Vessel E Before OWS**					
	Laboratoriets provnummer	*ST2107353-027*					
	Provtagningsdatum / tid	*2021-03-28*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	0.80 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

	Provbeteckning	**94 Vessel E After OWS**					
	Laboratoriets provnummer	*ST2107353-028*					
	Provtagningsdatum / tid	*2021-03-28*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

	Provbeteckning	**1004 Vessel F Before OWS**					
	Laboratoriets provnummer	*ST2107353-029*					
	Provtagningsdatum / tid	*2021-03-28*					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	0.48 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning	**1014 Vessel F After OWS**						
Laboratoriets provnummer	*ST2107353-030*						
Provtagningsdatum / tid	*2021-03-28*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning	**1024 Vessel G Before OWS**						
Laboratoriets provnummer	*ST2107353-031*						
Provtagningsdatum / tid	*2021-03-28*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	0.49 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning	**1034 Vessel G After OWS**						
Laboratoriets provnummer	*ST2107353-032*						
Provtagningsdatum / tid	*2021-03-28*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Övriga parametrar							
katjoniska tensider	<0.25 *	----	mg/L	0.25	Tensider, katjoniska	W-SURC-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning	**65 Vessel D Before OWS**						
Laboratoriets provnummer	*ST2107353-033*						
Provtagningsdatum / tid	*2021-03-28*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	0.50	± 0.17	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**

Provbeteckning	**75 Vessel D After OWS**						
Laboratoriets provnummer	*ST2107353-034*						
Provtagningsdatum / tid	*2021-03-28*						
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	<0.20	----	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*	**85 Vessel E Before OWS**					
	Laboratoriets provnummer	ST2107353-035					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	8.69	± 1.74	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*	**95 Vessel E After OWS**					
	Laboratoriets provnummer	ST2107353-036					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	4.66	± 0.94	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*	**1005 Vessel F Before OWS**					
	Laboratoriets provnummer	ST2107353-037					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	0.34	± 0.15	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*	**1015 Vessel F After OWS**					
	Laboratoriets provnummer	ST2107353-038					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	0.31	± 0.15	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**	*Provbeteckning*	**1025 Vessel G Before OWS**					
	Laboratoriets provnummer	ST2107353-039					
	Provtagningsdatum / tid	2021-03-28					
Parameter	**Resultat**	MU	*Enhet*	*LOR*	*Analys paket*	*Metod*	*Utf.*
Oorganiska parametrar							
nonjoniska tensider	1.61	± 0.35	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Matris: **HAVSVATTEN**			Provbeteckning	**1035 Vessel G After OWS**			
			Laboratoriets provnummer	ST2107353-040			
			Provtagningsdatum / tid	2021-03-28			
Parameter	Resultat	MU	Enhet	LOR	Analys paket	Metod	Utf.
Oorganiska parametrar							
nonjoniska tensider	0.29	± 0.14	mg/L	0.20	Tensider, nonjoniska	W-SURN2-PHO	CS

Metodsammanfattningar

Analysmetoder	Metod
W-SURA-CFA	Spektrofotomtrisk bestämning av anjoniska tensider genom mätning av metylenblått index (MBAS) enligt metod CSN ISO 16265, SKALAR och CSN EN 903.
W-SURC-PHO*	Bestämning av katjoniska tensider med bromfenolblå (BAC) enligt intern metod.
W-SURN2-PHO	Bestämning av nonjoniska tensider (BiAS) spektrofotometriskt med en HACH kyvett enligt intern metod.
W-PAHGMS05	Bestämning av polycykliska aromatiska kolväten, PAH (16 föreningar enligt EPA), enligt metod baserad på US EPA 8270D, US EPA 8082A, CSN EN ISO 6468 och US EPA 8000D. Mätning utförs med GC-MS eller GC-MS/MS. PAH cancerogena utgörs av bens(a)antracen, krysen, bens(b)fluoranten, bens(k)fluoranten, bens(a)pyren, dibens(ah)antracen och indeno(123cd)pyren. Bestämning av polycykliska aromatiska kolväten; summa PAH L, summa PAH M och summa PAH H. Summa PAH L: naftalen, acenaften och acenaftylen. Summa PAH M: fluoren, fenantren, antracen, fluoranten och pyren. Summa PAH H: bens(a)antracen, krysen, bens(b)fluoranten, bens(k)fluoranten, bens(a)pyren, indeno(1,2,3-c,d)pyren, dibens(a,h)antracen och bens(g,h,i)perylen). PAH summorna är definerade enligt direktiv från Naturvårdsverket utgivna i oktober 2008.
W-TPHFID01	Bestämning av oljeindex enligt metod CSN EN ISO 9377-2, US EPA 8015, US EPA 3510, TNRCC Metod 1006. Mätning utförs med GC-FID.

Nyckel: **LOR** = Den rapporteringsgräns (LOR) som anges är standard för respektive parameter i metoden. Rapporteringsgränsen kan påverkas vid t.ex. spädning p.g.a. matrisstörningar, begränsad provmängd eller låg torrsubstanshalt.

MU = Mätosäkerhet

***** = Asterisk efter resultatet visar på ej ackrediterat test, gäller både egna lab och underleverantör

Mätosäkerhet:

Mätosäkerheten anges som en utvidgad osäkerhet (enligt definitionen i "Evaluation of measurement data- Guide to the expression of uncertainty in measurement", JCGM 100:2008 Corrected version 2010) beräknad med täckningsfaktor lika med 2 vilket ger en konfidensnivå på ungefär 95%.
Mätosäkerhet anges endast för detekterade ämnen med halter över rapporteringsgränsen.

Mätosäkerhet från underleverantör anges oftast som en utvidgad osäkerhet beräknad med täckningsfaktor 2. För ytterligare information kontakta laboratoriet.

Utförande laboratorium (teknisk enhet inom ALS Scandinavia eller anlitat laboratorium (underleverantör)).

	Utf.
CS	*Analys utförd av* ALS Czech Republic s.r.o Česká Lípa, Bendlova 1687/7 Česká Lípa Tjeckien 470 01 Ackrediterad av: CAI Ackrediteringsnummer: 1163
PR	*Analys utförd av* ALS Czech Republic s.r.o Prag, Na Harfe 336/9 Prag Tjeckien 190 00 Ackrediterad av: CAI Ackrediteringsnummer: 1163

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