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D 2.3 Report on enhanced oil remediation in oil polluted sediments using electrokinetic treatment

WP2: Oil biodegradation and bioremediation

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Executive Summary

Lamor Corporation Ab (Lamor) has introduced an innovative technology for contaminated soil, water and sediment remediation. The technology is based on an electrokinetic method initiating biological and chemical degradation of hydrocarbons.

Lamor implemented as a lead partner together with SYKE the task 2.3 “Remediation of oil contaminated sediments using electrokinetic treatment” in the GRACE project funded by the EU. The pilot-test was implemented with the EKOGRID™ method targeting to clean up oil polluted sediments in the marine environment. This is a method for post spill actions if sediment has become polluted with petroleum hydrocarbons, and it is not a part of the immediate oil spill response methods.

The pilot-test was carried out in Töölönlahti Bay in Helsinki, Finland. The site is a shallow almost completely closed former bay of the Gulf of Finland near Helsinki Central Railway station. Töölönlahti Bay has partially been filled with various organic and inorganic waste masses that contain also petroleum hydrocarbons and polycyclic aromatic hydrocarbons (PAHs). Due to its history Töölönlahti Bay has also been heavily eutrophicated.

The electrodes and cables were installed in August 2017 at three distinct areas and a control area of sea sediment using a mobile floating platform. The project has included four sediment sampling campaigns. Various physical, chemical and biological parameters have been analyzed of the samples.

So far it is difficult to make clear conclusions on the effects of the treatment, due to large variation in the sediment between the test plots. The results show so far that electrokinetic treatment may enhance degradation of petroleum hydrocarbons in one of the plots, but not in the other two plots. As expected, the remediation may be most efficient in the warm summer season. The pilot-test is anticipated to continue till end of October 2018 to utilize the entire warm period of 2018. Two more sampling campaigns, one in August and the last one in October 2018 are planned to be carried out.

The pilot-test has been co-funded by the GRACE project and the ERASED project funded by Tekes (the Finnish Funding Agency for Technology and Innovation), and done in collaboration with the Eko Harden Technologies Oy, the Finnish Environmental Institute and the City of Helsinki. The target of the pilot-test in ERASED project is to reduce impacts of eutrophication. These two targets have a clear synergy, because biological degradation of hydrocarbons consumes nutrients.

Concept of EKOGRID™ electrokinetic treatment

EKOGRID™ is an electrokinetic method utilizing natural well-known phenomena and reactions. The method was initially developed for dewatering of concrete. Later the method was developed for soil and groundwater remediation (Masavat et al 2012). EKOGRID™ is most effective in poorly permeable and wet soil matrices that are challenging for all other treatment methods. EKOGRID™ can be applied both *in situ*, where the treatment is done without excavation, and for excavated masses. The method has been used also for treatment of bottom sediments.

Processes of electro-osmosis (forced flow of water), electrophoresis (forced flow of charged particles) and electromigration (forced solute movement) between anode and cathode cause the contents of the soil pores and soil water to be mixed and bioavailability of elements and compounds to increase. The smallest soil pores are flushed by the external force of the electric field pulling the water out and letting it back. Electrical current decrease surface potential of polar molecules, such as oil hydrocarbons and increase their solubility. In old polluted sites contaminants can be bound strongly to micropores of the soil matrix, and they are difficult to contact with physical and chemical methods. So-called back-diffusion that releases contaminants from solid phase to soluble and gaseous phases is typically a slower process than sorption of contaminants. The processes stated above cause absorbed contaminants to be available to be removed or degraded by other remediation processes.

Electrochemical redox reactions lead into electrolysis of water and further reactions within the soil utilizing hydroxyl radicals and oxygen as electron acceptors and reduced iron and manganese cations as electron donors. Hydroxyl radicals reduce by chemical oxidation excessive organic content and contaminants of the soil matrix. Oxidation produces aerobic conditions, which interrupt progress of eutrophication and reduce the concentrations of the harmful substances such as hydrogen sulphide and ammonia that commonly occur in gaseous and soluble states under anaerobic conditions.

Increased oxidation and electricity stimulate microbial activity and provide oxygen, which together enhance bioremediation of oil hydrocarbons and reduce the leakage of nutrients from the sediment.

Secondary targeted physical process is compaction of sediment, which increases the thickness of water bed and reduces leachability of contaminants and nutrients.

An essential difference of EKOGRID™ compared to other electrokinetic methods is the patented square-formed pulsed voltage input system, which changes polarity between anode and cathode. By shifting the polarity development of extreme conditions in the immediate vicinity of electrodes such as extreme pH and production of hydrogen gas can be avoided. In addition, by shifting the polarity, electrodes can be protected against corrosion. Several versions of square-formed pulses have been developed for different types of soil matrices. This makes the hydrated cations in the soil matrix pores move quickly back and forward. As the polarity shifts free radicals and oxygen are formed by the excessive energy charged in to the soil system. The system uses the capacitive nature of the matrix (soil) thus enabling the functioning with a very low output voltage (typically from 5 V to 20 V). Electrolytic reaction occurs at the particle surfaces, right where the pollutants are.

EKOGRID™ can be operated and monitored remotely online and by SMS.

Test site background and regulatory framework

Töölönlahti Bay is ca. 21 ha large flat-bedded almost completely closed bay connected to the Gulf of Finland. The average depth of water bed is 1.8 m and the deepest point is ca. 2.5 m. Till mid 1900-century Töölönlahti Bay has been point of discharge for municipal wastewaters. During the 1800's and 1900's also industrial plants such as sugar factory and gas works discharged their wastewaters to Töölönlahti Bay. (FCG Suunnittelu ja Tekniikka Oy. 2016 Töölönlahti, Helsinki, Sediment research)

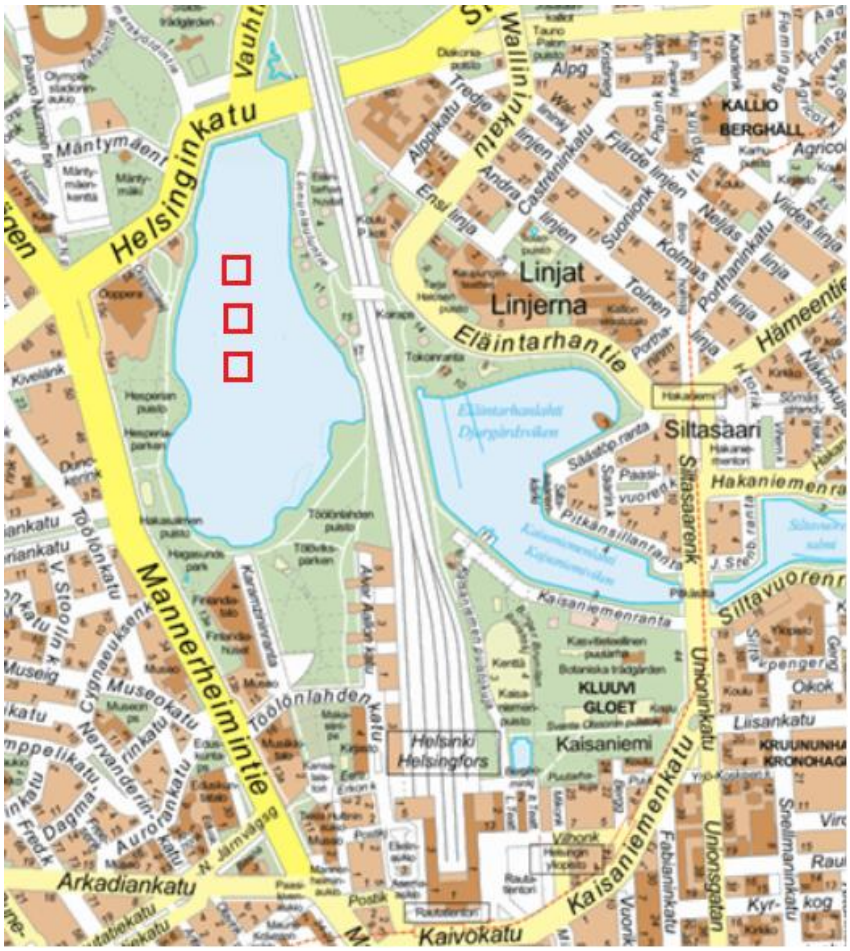

Figure 1. *Map of Töölönlahti Bay on location of research areas of the pilot-test.*

Finland has not set any threshold concentration values that could be used to assess the need for remediation of sediments. Finland has set quality criteria for disposal of dredged sediments to sea. Sediments that have concentrations below quality criteria 1 are considered to be eligible for disposal. More detailed quality criteria 1A, 1B and 1C have been set for different contaminants and scenarios. Sediments that have concentrations between quality criteria 1 and 2 may be eligible for disposal based on case-specific assessment. Sediments that have concentrations over quality criteria 2 are basically not considered to be eligible for disposal. The contaminant concentrations in sediments may be normalized with total organic carbon concentration. Sediment that has high organic carbon content is considered to sorb more organic contaminants, and thus higher concentrations of organic contaminants are considered to be acceptable in sediment with a lot of natural organic matter. The quality criteria for sediment are generally more conservative than target concentrations set for soil.

Finland has set natural background, threshold, lower and higher guideline concentrations and hazardous waste limit for soil, which can be used for risk assessment of the contamination. Lower guideline concentrations are usually used to assess residential areas and upper guideline concentrations industrial areas. Also, a case-specific assessment about health and ecological impacts of contaminants as well as their transportation mechanisms may be used to set case-specific clean-up target concentrations. Finland has set various recommendations and guidelines for contaminant concentrations in surface and ground waters as well.

Earlier environmental studies (FCG Suunnittelu ja Tekniikka Oy. 2016 Töölönlahti, Helsinki, Sediment research) of Töölönlahti Bay have focused on the top layer of the sediments. Anthropogenic influence can be noticed to a depth of more than 2 meters in the sediment. The uppermost part is mostly loose silt with organic content. A clay layer starts at depth 0.3-1.2 m. The thickness of the contaminated layer is on average ca. 0.4 m. The thickest and most contaminated sediments were found in southern parts of Töölönlahti Bay. The amount of sediment with concentrations over quality criterion 2 and lower guideline concentrations is in Töölönlahti Bay ca. 80 200 – 95 000 m^3. Observations of the following contaminants have been made:

- Mercury, cadmium, copper, lead, zinc, nickel, petroleum hydrocarbons, PCB and polycyclic aromatic hydrocarbons (PAHs) over quality criteria 2
- Mercury, copper, zinc and oil hydrocarbons over upper guideline concentrations
- Lead and polycyclic aromatic hydrocarbons lower guideline concentrations
- No concentrations over hazardous waste limit has been observed
- Oil hydrocarbons are initially mostly in aliphatic form in fraction C_{16}-C_{35}

System installation and treatment works

The research area was selected to be 100 m X 100 m. Inside the research area there are three replicate areas sized 15 m X 15 m, each with its own control area. 16 steel electrodes were installed to each replicate area to a 5 m grid. The electrodes were pushed manually into 2 m of the soft sediment in late August 2017. Platforms were used to install and anchor the electrodes in the pilot-test. Cables were laid on the bottom of the bay from electrodes to the control box.

A constant electrical current of total max 800 W was applied to each replicate area. The treated volume of each three replicate areas was 90 m^3.

Figure 2. *Left: 3 platforms used for installation and anchoring of electrodes (photo: Ossi Tonteri). Right: EKOGRID™ Control box (photo Laura Hoikkala).*

Figure 3. *Platforms in winter time (photo Ossi Tonteri).*

Sampling campaigns and analysis results

Four sampling campaigns were designed to be implemented between September 2017 and June 2018 (before installation, after installation, during treatment and at the end of treatment). Sampling were designed to collect samples from 0-50 cm depth, in two parts depths 0-30 cm and 30-50 cm. The schedule of sampling is attached as appendix 1 of this report. However, it was not possible to get that deep samples so only 30 cm was taken.

During writing of this Deliverable initial background samples and three sampling campaigns have been done. The treatment was not commenced and sampling campaigns were not done on the same dates in different areas. Both the cumulative week since commencement of the treatment in the respective area and the date of sampling are indicated in figures 5, 6 and 7.

Sampling was performed with a device that is a variation of Limnos soft sediment sampler. It proved out to be challenging to sample the entire anticipated 50 cm column. Soft sediment escaped easily from the sampler. Thus, most results are taken as one column on depth 0-30 cm. Three replicate samples were taken within each treatment and control replicate area.

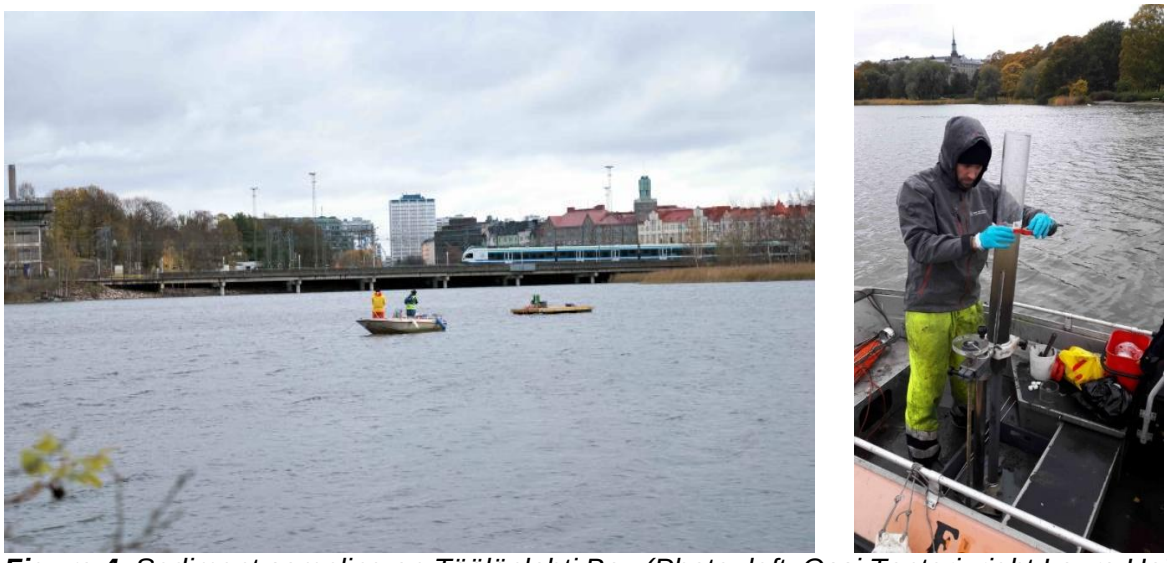

Figure 4. *Sediment sampling on Töölönlahti Bay (Photo: left: Ossi Tonteri, right Laura Hoikkala).*

Before the electrodes were installed, the areas were sampled for an estimate of the background concentration variation study.

Various analyses were done of the sediment samples as part of GRACE and ERASED programs. The analyses in the GRACE program were selected to monitor development of remediation and other influence of electrokinetic treatment on the sediment. The analyzes in the GRACE program included dry matter, loss on ignition +550 °C, pH, petroleum hydrocarbons C_{10}-C_{40} and the petroleum hydrocarbon fraction C_{10}-C_{21} and >C_{21}-C_{40} (ISO 11046 and ISO 16703), PAH(16) (ISO 18287 and CEN/TS 16181), total extractable aliphatic and aromatic hydrocarbons C_{10}-C_{35} (CEN ISO/TS 16558-2) with fractionation, water content, bulk density, DAPI (microbiological cell count). Concise tables of the laboratory analyses results and analysis certificates from the GRACE project are attached as appendices 1 and 2, respectively as part of this report.

The sediment analyses of the ERASED program included total phosphorus, nitrogen and various other nutrients; soluble ammonium, nitrite, nitrate, phosphate, dissolved organic nitrogen, dissolved organic phosphorus fractions, dissolved organic and inorganic carbon; sediment sorption and surface area properties, dissolved metals, sediment metal oxides related to phosphorus absorption. Samples of the ERASED program were taken at more detailed depth intervals than in GRACE for more detailed assessment of the biogeochemistry in the surface sediment. ERASED program included also mineralization tests of organic matter tests implemented in laboratory. These results are not included in this report.

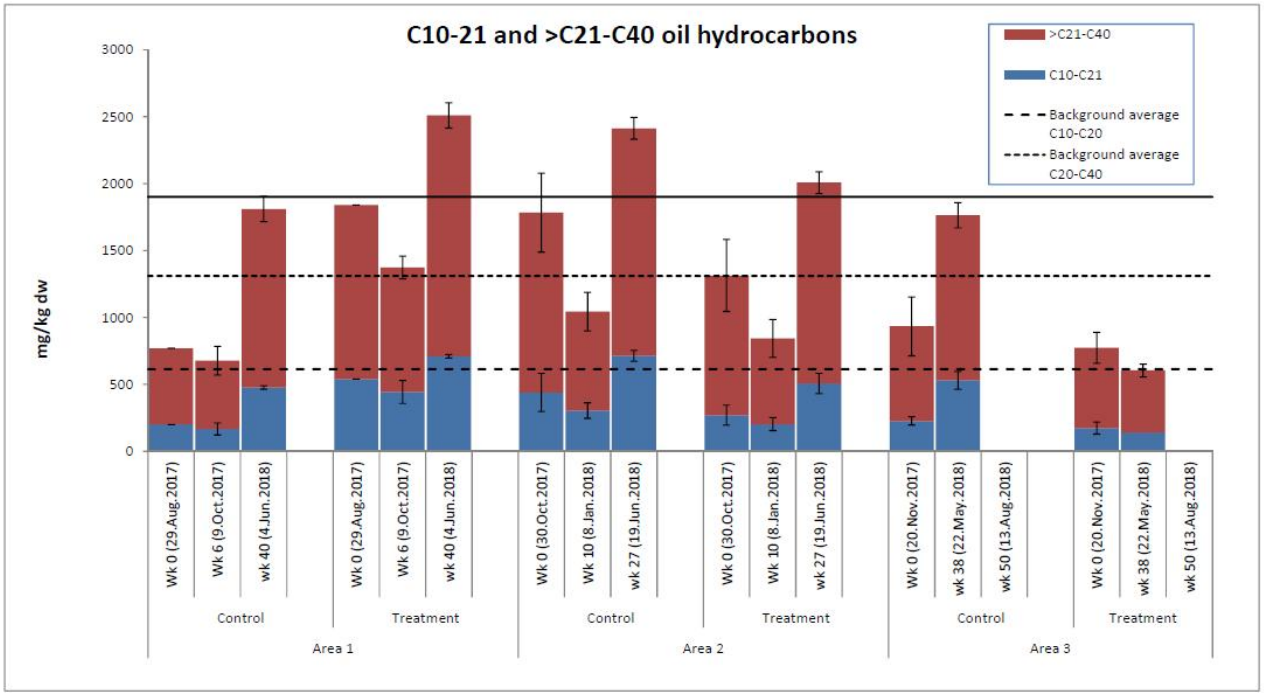

Figure 5. *Changes in petroleum hydrocarbons C_{10}-C_{21} and >C_{21}-C_{40} concentrations during pilot-test.*

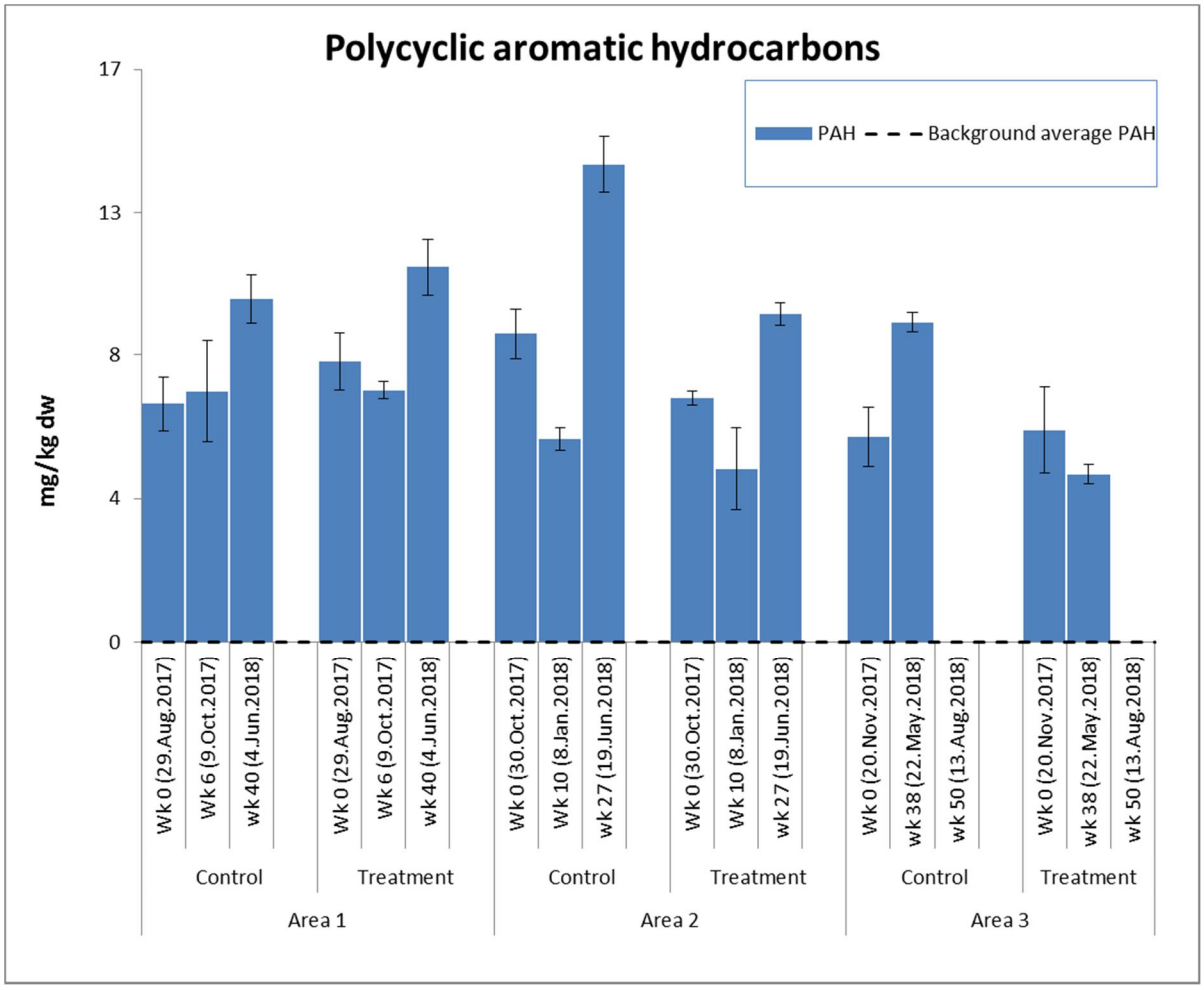

Figure 6. *Changes in the concentrations of the sum of 16 polycyclic aromatic hydrocarbons (PAHs) during the electrokinetic treatment.*

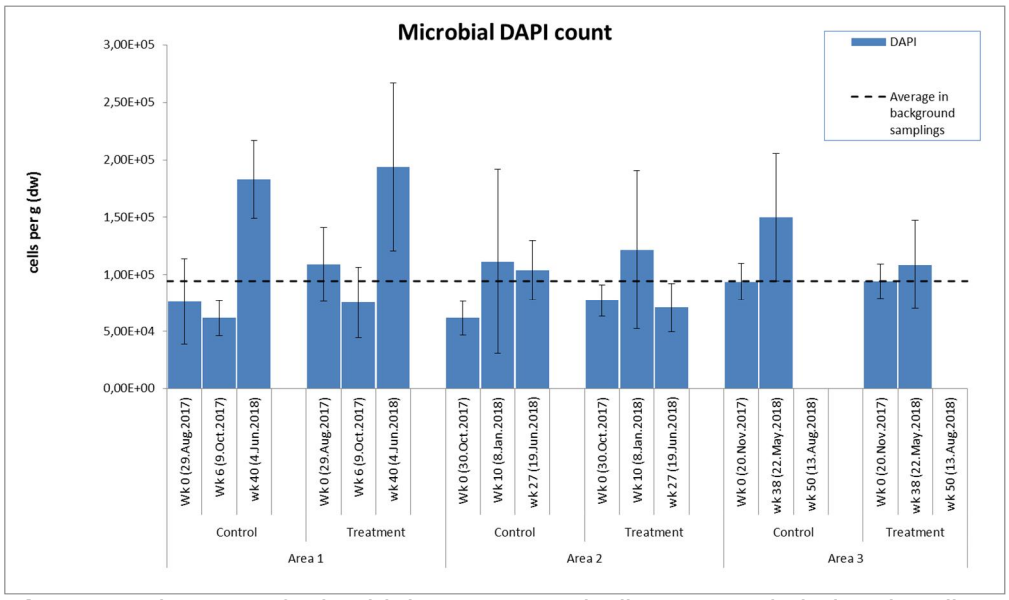

Figure 7. *Changes of microbial DAPI count (cells per gram) during the pilot-test.*

The depth of Töölönlahti and its sediment layers were surveyed with echo sounding radar equipment in February 2018. The surveyed area was 0.9 hectares. The radar produced credible results to a sediment layer of 5 m thickness. The sediment was compacted in 25 points. The compacted points were small though with diameter of 50-70 cm and 15-20 cm deep.

Interpretation of the remediation outcome

As could be expected for any treatment that involves biodegradation, electrokinetic treatment would also be most efficient in the summertime. However, this was not clearly observed so far. Some degradation of petroleum hydrocarbons C_{10}-C_{40} could be observed temporarily in area 2 and most clearly in area 3, when comparing the results in control and treatment areas (Fig 5). In area 1, there was so far no clear trend of reduction in C_{10}-C_{40} petroleum hydrocarbons in sediment.

As can be seen in Appendix 1 table of laboratory analyses results, there is a contrast between the results for C_{10}-C_{40} petroleum hydrocarbon and total extractable hydrocarbon THC >C_{10}-C_{35} concentrations, which can be caused by influence of non-petroleum originated hydrocarbons in the results especially in the total extractable hydrocarbon C_{10}-C_{35} analysis. In the C_{10}-C_{40} analysis the sample was cleaned up with a florisil column to remove polar hydrocarbons. During the fractionation of the THC C_{10}-C_{35} extracts the sample is passed through a silicate column, which removes some of the polar hydrocarbon compounds in the fractions. Non-oil originated hydrocarbons may be a significant source of uncertainty in sediments that contain ca. 10-15 % of organic matter.

The initial and background concentrations of sum of 16 polycyclic aromatic hydrocarbon compounds (PAHs) was relatively low, below environmentally set threshold concentrations 15 mg/kg (Fig 6). In area 3 there was a slight decrease in PAH concentrations in the treatment plots during the treatment period. In area 2 the PAH concentrations first declined and then increased in both control and treatment plots. In area 1 the PAH concentrations increased during the treatment in both the control and treatment plots.

DAPI microbiological count levels in the sediment were relatively low, cell numbers were in all samples between 10^4-10^5 cells per g (dw) sediment (Fig 6). In all samples the microbes were visually small (ca.1-10 µm) and had round or rod shape. In the area 1, the microbe numbers were

higher in 3rd sampling compared to first two samplings. But in experiment area 2, no significant increase was observed. There was also some increase on the 2nd sampling of area 3. However, as the latest samplings were done during spring/summer months, the increases could be explained by seasonal changes in microbial activity.

As changes in petroleum hydrocarbon concentrations of control and treatment are compared, a significant uncertainty most likely due to sampling and the natural variability in the sediment can be noticed. The uncertainty is caused by heterogeneity of the site. The uncertainty in concentrations was countered by taking several parallel samples. Each control and treatment concentration result is an arithmetic average of three replicate measurements. Furthermore, the treatment commenced, and samples were taken in area 1 earlier and in area 3 later than in the other areas. The difference of sampling dates was many months, may also explain difference in degradation curves partially. Therefore it is so far difficult to make clear conclusions on the effects of the remediation.

Initial hypothesis was that EKOGRID^{TM} moves clay particles closer to each other as water is drained away by the electrical field. Clay particles with negative surface are glued together by the H^{+} releasing Al^{3+} and Fe^{+3} from the particles surfaces. Multivalent cations bind together the clay particles solidifying the compaction. Compaction caused by drying of water bodies above muddy sediments has a similar effect. The sediment compaction is dependent on biological phenomena. Radar results proved that some compaction occurred, but only on immediate vicinity of the electrodes.

The pilot test has been decided to be extended till end of October 2018 to study remediation performance during the summer season, when remediation is expected to be the most efficient. Two more sampling campaigns are designed to be done in all three areas.

Furthermore, samples for DNA extraction and analysis of genes related to petroleum hydrocarbon degradation have been taken and will be analyzed during the autumn of 2018. Furthermore, some of the samples will be selected for microbial community analysis using 16S rDNA sequencing if the last results on the treatment are promising. These data will be included in D2.5 Report on results of omics data meta-analysis.

Also, samples for testing of the toxicity of the remediated sediment have been taken and will be sent to RWTH and tested for D 2.4 Report on effect-based assessment of biodegradation and remediation success.

References

Masavat, N., Oh, E., and Chai, G. 2012. A review of electrokinetic treatment technique for improving the engineering characteristics of low permeable problematic soils. Int. J. of GEOMATE 2: 266-272.

FCG Suunnittelu ja Tekniikka Oy. 2016 Töölönlahti, Helsinki, Sediment research (in Finnish). Report for City of Helsinki.

ISO 16703:2004 Soil quality -- Determination of content of hydrocarbon in the range C10 to C40 by gas chromatography

		Background sampling Experiment area 1.									
Sample name	Unit	O1A 0-30	O1A 30-35	O1B 0-30	O1B 30-33	O1C 0-30	O1C 30-35	Average	Std	Average	Std
Real sample depth	cm	0-30	30-35	0-30	30-33	0-30	30-35				
Sample date		14.8.2017	14.8.2017	14.8.2017	15.8.2017	15.8.2017	15.8.2017	01 0-30	01 0-30	01 30-3x	01 30-3x
Dry matter	m-%	21	28	21	28	23	28	21,7	0,9	28,0	0,0
Loss on ignition 550 °C	%	13	9,8	13	9,3	13	10	13,0	0,0	9,7	0,3
pH soil/solid		7,7	8,3	7,9	8,4	8	8,3	7,9	0,1	8,3	0,0
Hydrocarbon fractions C10-C40, soil	mg/kg dw	-	-	1300	130	-	-	1300,0	0,0	130,0	0,0
Middle distillates C10-C21	mg/kg dw	-	-	390	<40	-	-	390,0	0,0	<40	0,0
Heavy oil fractions C21-C40	mg/kg dw	-	-	930	96	-	-	930,0	0,0	96,0	0,0
PAH, Sum EPA16	mg/kg dw	12,00	2,70	11,00	1,50	7,30	1,30	10,10	2,02	1,83	0,62
Anthracene	mg/kg dw	0,36	0,08	0,33	0,04	0,21	0,04	0,30	0,06	0,05	0,02
Acenaphthene	mg/kg dw	0,17	0,05	0,12	0,03	0,07	0,03	0,12	0,04	0,04	0,01
Acenaphthylene	mg/kg dw	0,16	0,02	0,13	0,01	0,09	0,01	0,13	0,03	0,01	0,00
Benzo (a) anthracene	mg/kg dw	0,58	0,16	0,56	0,10	0,40	0,08	0,51	0,08	0,11	0,03
Benzo (a) pyrene	mg/kg dw	0,54	0,13	0,57	0,08	0,38	0,07	0,50	0,08	0,09	0,03
Benzo (b + j) fluoranthene	mg/kg dw	1,20	0,23	1,10	0,14	0,74	0,12	1,01	0,20	0,16	0,05
Benzo (k) fluoranthene	mg/kg dw	0,39	0,07	0,36	0,05	0,23	0,04	0,33	0,07	0,05	0,01
Benzo (g, h, i) perylene	mg/kg dw	0,61	0,13	0,60	0,08	0,39	0,06	0,53	0,10	0,09	0,03
Dibenzo (a, h) anthracene	mg/kg dw	0,11	0,02	0,11	0,01	0,07	0,01	0,10	0,02	0,02	0,00
phenanthrene	mg/kg dw	1,20	0,20	0,96	0,11	0,66	0,11	0,94	0,22	0,14	0,04
fluoranthene	mg/kg dw	2,70	0,69	2,40	0,36	1,70	0,31	2,27	0,42	0,45	0,17
fluorene	mg/kg dw	0,29	0,08	0,20	0,04	0,13	0,03	0,21	0,07	0,05	0,02
Indeno (1,2,3-cd) pyrene	mg/kg dw	0,53	0,12	0,53	0,07	0,35	0,06	0,47	0,08	0,08	0,03
chrysene	mg/kg dw	0,66	0,17	0,56	0,09	0,39	0,08	0,54	0,11	0,11	0,04
naphthalene	mg/kg dw	0,29	0,03	0,23	0,02	0,15	0,02	0,22	0,06	0,02	0,01
pyrene	mg/kg dw	2,2	0,54	2	0,3	1,4	0,25	1,9	0,3	0,4	0,1
Aliphatic and aromatic hydrocarbons> C5-C10	mg/kg dw	ok	ok	ok	ok	ok	ok	-	-	-	
Aliphatic and aromatic hydrocarbons> C10-C35	mg/kg dw	ok	ok	ok	ok	ok	ok	-	-	-	
THC> C5-C10	mg/kg dw	<10	<10	<10	<10	<10	<10	-	-	-	
THC> C10-C35	mg/kg dw	3700	370	2800	200	1600	170	2700,0	860,2	246,7	88,1
The aliphatic C5-C6	mg/kg dw	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5				
Aliphatic> C6-C8	mg/kg dw	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5				
Aliphatic> C8-C10	mg/kg dw	<5	<5	<5	<5	<5	<5				
Aliphatic> C10-C12	mg/kg dw	<30	<20	<30	<20	<30	<20				
Aliphatic> C12-C16	mg/kg dw	180	<20	98	<20	58	<20				
Aliphatic> C16-C35	mg/kg dw	1900	240	1200	96	840	92	1313,3	440,1	142,7	68,8
aromatic C6	mg/kg dw	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5				
Aromatic> C6-C8	mg/kg dw	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5				
Aromatic> C8-C10	mg/kg dw	<5	<5	<5	<5	<5	<5				
Aromatic> C10-C12	mg/kg dw	<30	<20	<30	<20	<30	<20				
Aromatic> C12-C16	mg/kg dw	<30	<20	<30	<20	<30	<20				
Aromatic> C16-C21	mg/kg dw	170	<20	110	<20	66	<20				
Aromatic> C21-C35	mg/kg dw	530	68	430	28	270	24	410,0	107,1	40,0	19,9
Determination of water content	w%	373,7	254,9	363,6	242,9	361,7	264,3	366,3	5,3	254,0	8,8
Determination of the bulk density		1,15	1,2	1,13	1,22	1,15	1,19	1,1	0,0	1,2	0,0
DAPI	cells per g (dw)	9,29E+04	4,24E+04	8,44E+04	2,94E+04	9,45E+04	2,40E+04	9,06E+04	4,45E+03	3,19E+04	7,69E+03

Background sampling Experiment area 2.										Background sampling Experiment area 3.									
O2A 0-30 0-30	O2A 30-34 30-34	O2B 0-30 0-30	O2B 30-40 30-40	O2C 0-30 0-30	O2C 30-37 30-37	Average	Std	Average	Std	O3A 0-30 0-30	O3A 30-34 30-34	O3B 0-30 0-30	O3B 30-35 30-35	O3C 0-30 0-30	O3C 30-37 30-37	Average	Std	Average	Std
15.8.2017	15.8.2017	15.8.2017	15.8.2017	15.8.2017	16.8.2017	0-30	0-30	30-3x	02 30-3x	16.8.2017	16.8.2017	16.8.2017	16.8.2017	16.8.2017	16.8.2017	0-30	0-30	30-3x	30-3x
21	25	19	25	22	28	20,7	1,2	26,0	1,4	21	19	21	19	21	17	21,0	0,0	18,3	0,9
14	11	15	11	13	9,4	14,0	0,8	10,5	0,8	14	17	14	16	14	17	14,0	0,0	16,7	0,5
7,5	8	7,6	8,1	7,6	8,2	7,6	0,0	8,1	0,1	7,4	7,6	7,5	7,7	7,3	7,5	7,4	0,1	7,6	0,1
-	-	2300	340	-	-	2300,0	0,0	340,0	0,0	-	-	2100	3000	-	-	2100,0	0,0	3000,0	0,0
-	-	760	100	-	-	760,0	0,0	100,0	0,0	-	-	690	840	-	-	690,0	0,0	840,0	0,0
-	-	1600	240	-	-	1600,0	0,0	240,0	0,0	-	-	1400	2100	-	-	1400,0	0,0	2100,0	0,0
11,00	6,80	13,00	5,00	7,80	1,40	10,60	2,14	4,40	2,24	12,00	32,00	11,00	29,00	11,00	31,00	11,33	0,47	30,67	1,25
0,29	0,20	0,40	0,13	0,19	0,04	0,29	0,09	0,12	0,07	0,35	0,92	0,36	0,84	0,33	0,90	0,35	0,01	0,89	0,03
0,10	0,08	0,15	0,07	0,06	0,03	0,10	0,04	0,06	0,02	0,12	0,32	0,14	0,30	0,13	0,35	0,13	0,01	0,32	0,02
0,15	0,06	0,19	0,04	0,11	0,01	0,15	0,03	0,04	0,02	0,14	0,23	0,17	0,24	0,19	0,24	0,17	0,02	0,24	0,00
0,56	0,41	0,65	0,29	0,42	0,09	0,54	0,09	0,26	0,13	0,62	2,20	0,52	1,70	0,55	2,30	0,56	0,04	2,07	0,26
0,57	0,37	0,64	0,25	0,45	0,07	0,55	0,08	0,23	0,12	0,64	1,80	0,52	1,60	0,56	1,90	0,57	0,05	1,77	0,12
1,10	0,67	1,20	0,47	0,87	0,12	1,06	0,14	0,42	0,23	1,20	3,20	1,00	2,90	1,10	3,20	1,10	0,08	3,10	0,14
0,36	0,21	0,40	0,15	0,27	0,04	0,34	0,05	0,13	0,07	0,37	1,10	0,32	0,84	0,32	0,99	0,34	0,02	0,98	0,11
0,59	0,37	0,66	0,25	0,46	0,07	0,57	0,08	0,23	0,12	0,66	1,60	0,51	1,60	0,54	1,60	0,57	0,06	1,60	0,00
0,11	0,07	0,12	0,05	0,09	0,01	0,11	0,01	0,04	0,02	0,13	0,36	0,10	0,32	0,11	0,36	0,11	0,01	0,35	0,02
1,00	0,44	1,30	0,42	0,74	0,12	1,01	0,23	0,33	0,15	1,10	3,00	1,10	2,70	1,20	2,70	1,13	0,05	2,80	0,14
2,30	1,60	2,80	1,20	1,60	0,31	2,23	0,49	1,04	0,54	2,50	6,80	2,30	6,30	2,30	6,70	2,37	0,09	6,60	0,22
0,22	0,11	0,32	0,09	0,14	0,03	0,23	0,07	0,08	0,03	0,23	0,60	0,29	0,57	0,27	0,54	0,26	0,02	0,57	0,02
0,52	0,33	0,59	0,22	0,41	0,06	0,51	0,07	0,20	0,11	0,59	1,60	0,46	1,40	0,49	1,60	0,51	0,06	1,53	0,09
0,57	0,44	0,69	0,34	0,43	0,08	0,56	0,11	0,29	0,15	0,65	2,40	0,56	2,00	0,59	2,40	0,60	0,04	2,27	0,19
0,26	0,09	0,33	0,07	0,15	0,02	0,25	0,07	0,06	0,03	0,22	0,25	0,26	0,61	0,28	0,27	0,25	0,02	0,38	0,17
1,9	1,3	2,3	0,98	1,4	0,26	1,9	0,4	0,8	0,4	2	5,2	1,9	4,9	1,9	5,3	1,9	0,0	5,1	0,2
ok	ok	ok	ok	ok	ok	-	-	-		ok	ok	ok	ok	ok	ok	-	-	-	
ok	ok	ok	ok	ok	ok					ok	ok	ok	ok	ok					
						-	-	-							ok	-	-	-	
<10	<10	<10	<10	<10	<10	-	-	-		<10	<10	<10	<10	<10	<10	-	-	-	
3000	990	4300	580	1700	150	3000,0	1061,4	573,3	343,0	2800	6800	3700	5900	3500	5300	3333,3	385,9	6000,0	616,4
<0,5	<0,5	<0,5	<0,5	<0,5	<0,5					<0,5	<0,5	<0,5	<0,5	<0,5	<0,5				
<0,5	<0,5	<0,5	<0,5	<0,5	<0,5					<0,5	<0,5	<0,5	<0,5	<0,5	<0,5				
<5	<5	<5	<5	<5	<5					<5	<5	<5	<5	<5	<5				
<30	<20	<30	<20	<30	<20					<30	89	<30	61	<30	66				
140	34	240	24	76	<20	152,0	67,5	29,0	5,0	180	340	240	270	190	260	203,3	26,2	290,0	35,6
1700	510	2300	330	1100	87	1700,0	489,9	309,0	173,3	1800	3800	2200	3100	2000	2900	2000,0	163,3	3266,7	385,9
<0,5	<0,5	<0,5	<0,5	<0,5	<0,5					<0,5	<0,5	<0,5	<0,5	<0,5	<0,5				
<0,5	<0,5	<0,5	<0,5	<0,5	<0,5					<0,5	<0,5	<0,5	<0,5	<0,5	<0,5				
<5	<5	<5	<5	<5	<5					<5	<5	<5	<5	<5	<5				
<30	<20	<30	<20	<30	<20					<30	<30	<30	<30	<30	<30				
<30	<20	45	<20	<30	<20					39	45	32	40	30	41				
130	51	230	35	130	<20	163,3	47,1	43,0	8,0	220	280	190	290	180	280	196,7	17,0	283,3	4,7
530	180	760	110	570	30	620,0	100,3	106,7	61,3	820	1200	650	1100	660	1200	710,0	77,9	1166,7	47,1
362,5	297,2	391,1	296,4	344,4	259,9	366,0	19,2	284,5	17,4	377,1	421	376,1	426,7	398,2	409,2	383,8	10,2	419,0	7,3
1,14	1,18	1,13	1,17	1,15	1,2	1,1	0,0	1,2	0,0	1,16	1,12	1,15	1,13	1,14	1,13	1,2	0,0	1,1	0,0
4,97E+04	4,72E+04	8,01E+04	4,49E+04	5,29E+04	3,40E+04	6,09E+04	1,36E+04	4,21E+04	5,75E+03	1,19E+05	2,43E+04	1,34E+05	1,27E+05	1,42E+05	1,54E+04	1,32E+05	9,93E+03	5,54E+04	5,04E+04

1. Experiment area 1. Sampling 29.08.2017 (wk 0)										1. Experiment area 2. Sampling 09.10.2017 (wk 6)									
1KA	1KB	1KC	Average	Std	1TA	1TB	1TC	Average	Std	1K2A	1K2B	1K2C	Average	Std	1T2A	1T2B	1T2C	Average	Std
0-30	0-30	0-30			0-30	0-30	0-30			0-30	0-30	0-30			0-30	0-30	0-30		
29.8.2017	29.8.2017	29.8.2017	1KA1	1KA1	29.8.2017	29.8.2017	29.8.2017	1TA1	1TA1	9.10.2017	9.10.2017	9.10.2017	1KA2	1KA2	9.10.2017	9.10.2017	9.10.2017	1TA2	1TA2
23	22	21	22,0	0,8	21	20	21	20,7	0,5	21	22	20	21,0	0,8	22	21	20	21,0	0,8
13	13	12	12,7	0,5	14	14	14	14,0	0,0	11	11	13	11,7	0,9	13	13	14	13,3	0,5
7,6	7,6	7,5	7,6	0,0	7,6	7,5	7,5	7,5	0,0	7,9	7,3	7,2	7,5	0,3	7,4	7,5	7,3	7,4	0,1
-	780	-	780,0	0,0	-	1900	-	1900,0	0,0	480	700	840	673,3	148,2	1600	1400	1200	1400,0	163,3
-	200	-	200,0	0,0	-	540	-	540,0	0,0	110	170	220	166,7	45,0	550	440	340	443,3	85,8
-	570	-	570,0	0,0	-	1300	-	1300,0	0,0	370	530	630	510,0	107,1	1000	980	810	930,0	85,2
7,80	7,20	5,90	6,97	0,79	9,10	8,40	7,10	8,20	0,83	5,7	7,00	9,30	7,33	1,49	7,50	7,60	7,00	7,37	0,26
0,23	0,21	0,18	0,21	0,02	0,29	0,28	0,22	0,26	0,03	0,13	0,19	0,19	0,17	0,03	0,16	0,17	0,16	0,16	0,00
0,11	0,10	0,08	0,10	0,01	0,18	0,16	0,15	0,16	0,01	0,045	0,05	0,07	0,05	0,01	0,09	0,10	0,07	0,08	0,01
0,12	0,10	0,09	0,10	0,01	0,16	0,19	0,15	0,17	0,02	0,071	0,10	0,14	0,10	0,03	0,11	0,13	0,10	0,11	0,01
0,37	0,34	0,29	0,33	0,03	0,40	0,37	0,30	0,36	0,04	0,31	0,43	0,51	0,42	0,08	0,37	0,38	0,36	0,37	0,01
0,38	0,35	0,30	0,34	0,03	0,41	0,36	0,33	0,37	0,03	0,3	0,40	0,49	0,40	0,08	0,35	0,34	0,36	0,35	0,01
0,67	0,60	0,50	0,59	0,07	0,72	0,67	0,59	0,66	0,05	0,56	0,77	0,91	0,75	0,14	0,71	0,70	0,70	0,70	0,00
0,18	0,18	0,15	0,17	0,01	0,20	0,19	0,17	0,19	0,01	0,16	0,22	0,30	0,23	0,06	0,21	0,21	0,21	0,21	0,00
0,41	0,37	0,31	0,36	0,04	0,41	0,38	0,34	0,38	0,03	0,27	0,38	0,45	0,37	0,07	0,33	0,32	0,33	0,33	0,00
0,06	0,06	0,05	0,05	0,01	0,06	0,05	0,05	0,05	0,01	0,053	0,07	0,09	0,07	0,01	0,07	0,06	0,06	0,06	0,00
0,84	0,76	0,66	0,75	0,07	1,00	1,00	0,87	0,96	0,06	0,73	0,69	1,20	0,87	0,23	0,92	0,92	0,85	0,90	0,03
1,80	1,70	1,40	1,63	0,17	2,10	1,90	1,60	1,87	0,21	1,2	1,50	2,00	1,57	0,33	1,60	1,70	1,50	1,60	0,08
0,18	0,16	0,14	0,16	0,02	0,31	0,27	0,24	0,27	0,03	0,12	0,13	0,19	0,15	0,03	0,27	0,26	0,21	0,25	0,03
0,42	0,38	0,32	0,37	0,04	0,43	0,38	0,36	0,39	0,03	0,27	0,39	0,46	0,37	0,08	0,33	0,32	0,34	0,33	0,01
0,34	0,33	0,25	0,31	0,04	0,38	0,34	0,26	0,33	0,05	0,31	0,34	0,46	0,37	0,06	0,35	0,37	0,34	0,35	0,01
0,24	0,23	0,16	0,21	0,04	0,30	0,27	0,23	0,27	0,03	0,15	0,16	0,25	0,19	0,04	0,26	0,29	0,24	0,26	0,02
1,4	1,4	1,1	1,3	0,1	1,7	1,5	1,3	1,5	0,2	1	1,2	1,6	1,3	0,2	1,3	1,4	1,2	1,3	0,1
ok	ok	ok			ok	ok	ok			ok	ok	ok			ok	ok	ok		
ok	ok	ok			ok	ok	ok				ok	ok			ok	ok	ok		
										ok									
<10	<10	<10			<10	<10	<10			<10	<10	<10			<10	<10	<10		
2200	1600	1500	1766,7	309,1	3300	3600	2900	3266,7	286,7	890	1400	1600	1296,7	298,9	2800	2600	2000	2466,7	339,9
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<5	<5	<5			<5	<5	<5			<5	<5	<5			<5	<5	<5		
<30	<30	<30			<30	<30	<30			<30	<30	<30			<30	<30	<30		
84	66	46	65,3	15,5	200	210	170	193,3	17,0	<30	39	54	46,5	7,5	190	150	98	146,0	37,7
1300	870	780	983,3	226,9	2000	2000	1500	1833,3	235,7	480	740	940	720,0	188,3	1600	1500	1100	1400,0	216,0
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<5	<5	<5			<5	<5	<5			<5	<5	<5			<5	<5	<5		
<30	<30	<30			<30	<30	<30			<30	<30	<30			<30	<30	<30		
<30	<30	<30			<30	<30	<30			<30	<30	<30			31	<30	<30	31,0	0,0
100	60	44	68,0	23,6	120	120	110	116,7	4,7	31	52	79	54,0	19,6	130	110	87	109,0	17,6
470	240	230	313,3	110,9	410	440	420	423,3	12,5	150	240	350	246,7	81,8	420	380	340	380,0	32,7
347,9	357,8	331	345,6	11,1	404,8	364,8	370,2	379,9	17,7	289,9	368,2	355,2	337,8	34,3	380,2	366,4	382,4	376,3	7,1
Liite	Liite	Liite			Liite	Liite	Liite			1,18	1,13	1,13	1,1	0,0	1,09	1,11	1,12	1,1	0,0
1,2E+05	2,8E+04	8,2E+04	7,61E+04	3,76E+04	1,5E+05	7,7E+04	9,5E+04	1,09E+05	3,26E+04	6,4E+04	7,9E+04	4,2E+04	6,16E+04	1,54E+04	1,2E+05	6,1E+04	4,6E+04	7,53E+04	3,11E+04

1. Experiment area 3. Sampling 04.06.2018 (wk 40)										2. Experiment area 1. Sampling 30.10.2017 (wk 0)									
1K3A	1K3B	1K3C	Average	Std	1T3A	1T3B	1T3C	Average	Std	2KA	2KB	2KC	Average	Std	2TA	2TB	2TC	Average	Std
0-30	0-30	0-30			0-30	0-25(?)	0-30			0-25	0-10	0-20			0-23	0-30	0-30		
4.6.2018	4.6.2018	4.6.2018	1KA-C3	1TA-C3	4.6.2018	4.6.2018	4.6.2018	1TA-C3	1TA-C3	30.10.2017	30.10.2017	30.10.2017	2KA1	2KA1	30.10.2017	30.10.2017	30.10.2017	2TA1	2TA1
22	22	22	22,0	0,0	21	22	22	21,7	0,5	21	22	22	21,7	0,5	22	18	23	21,0	2,2
12	12	12	12,0	0,0	14	13	13	13,3	0,5	13	13	13	13,0	0,0	13	13	13	13,0	0,0
7,2	7,4	7,3	7,3	0,1	7,3	7,3	7,4	7,3	0,0	7,3	7,3	7,1	7,2	0,1	7,7	7,3	7,3	7,4	0,2
1800	1700	1900	1800,0	81,6	3200	2200	2100	2500,0	496,7	2100	2100	1200	1800,0	424,3	1200	940	1800	1313,3	360,1
480	460	490	476,7	12,5	920	610	600	710,0	148,5	520	560	240	440,0	142,4	250	190	370	270,0	74,8
1400	1200	1400	1333,3	94,3	2300	1600	1500	1800,0	355,9	1600	1500	930	1343,3	295,1	980	750	1400	1043,3	269,1
11,00	9,90	9,30	10,07	0,70	12,00	10,00	11,00	11,00	0,82	10,00	8,90	8,20	9,03	0,74	7,10	6,90	7,40	7,1	0,2
0,19	0,15	0,12	0,15	0,03	0,17	0,28	0,16	0,20	0,05	0,23	0,23	0,16	0,21	0,03	0,16	0,19	0,21	0,2	0,0
<0,15	<0,15	<0,15	0,00	0,00	<0,15	<0,15	<0,15	0,00	0,00	0,12	0,10	0,06	0,09	0,03	0,06	0,04	0,06	0,1	0,0
0,13	0,11	0,11	0,12	0,01	0,15	0,13	0,12	0,13	0,01	0,15	0,14	0,12	0,14	0,01	0,09	0,09	0,11	0,1	0,0
0,66	0,57	0,56	0,60	0,04	0,64	0,53	0,59	0,59	0,04	0,53	0,45	0,46	0,48	0,04	0,37	0,42	0,38	0,4	0,0
0,71	0,63	0,61	0,65	0,04	0,71	0,68	0,67	0,69	0,02	0,55	0,45	0,48	0,49	0,04	0,40	0,43	0,41	0,4	0,0
1,50	1,30	1,20	1,33	0,12	1,70	1,50	1,60	1,60	0,08	1,00	0,90	0,98	0,96	0,04	0,79	0,80	0,79	0,8	0,0
0,42	0,36	0,38	0,39	0,02	0,51	0,43	0,41	0,45	0,04	0,31	0,27	0,26	0,28	0,02	0,25	0,25	0,23	0,2	0,0
0,76	0,64	0,61	0,67	0,06	0,77	0,60	0,71	0,69	0,07	0,54	0,40	0,43	0,46	0,06	0,39	0,41	0,39	0,4	0,0
0,20	0,17	0,18	0,18	0,01	0,22	0,20	0,20	0,21	0,01	0,09	0,08	0,09	0,09	0,01	0,07	0,08	0,07	0,1	0,0
0,88	0,69	0,68	0,75	0,09	1,00	0,90	0,86	0,92	0,06	1,10	1,10	0,99	1,06	0,05	0,80	0,80	0,84	0,8	0,0
2,20	2,00	1,80	2,00	0,16	2,40	1,70	2,10	2,07	0,29	2,30	1,90	1,60	1,93	0,29	1,40	1,30	1,50	1,4	0,1
0,14	0,11	0,12	0,12	0,01	0,20	0,14	0,17	0,17	0,02	0,25	0,27	0,17	0,23	0,04	0,15	0,13	0,18	0,2	0,0
0,61	0,61	0,52	0,58	0,04	0,77	0,55	0,69	0,67	0,09	0,54	0,43	0,46	0,48	0,05	0,39	0,42	0,40	0,4	0,0
0,65	0,55	0,54	0,58	0,05	0,68	0,54	0,60	0,61	0,06	0,50	0,36	0,44	0,43	0,06	0,37	0,32	0,33	0,3	0,0
0,13	0,10	0,10	0,11	0,02	0,16	0,13	0,15	0,15	0,01	0,31	0,30	0,21	0,27	0,04	0,18	0,17	0,20	0,2	0,0
2,1	1,8	1,8	1,90	0,14	2,10	1,60	1,90	1,9	0,2	1,9	1,5	1,3	1,567	0,249	1,20	1,10	1,20	1,2	0,0
ok	ok	ok			ok	ok	ok			ok	ok	ok			ok	ok	ok		
ok	ok	ok			ok	ok	ok			ok	ok	ok			ok	ok	ok		
<10	<10	<10			<10	<10	<10			<10	<10	<10			<10	<10	<10		
3300	3200	3100	3200,0	81,6	4900	5000	3700	4533,3	723,4	4100	4100	3600	3933,3	235,7	3000	2900	3400	3100,0	216,0
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<5	<5	<5			<5	<5	<5			<5	<5	<5			<5	<5	<5		
<30	<30	<30			<30	<30	<30			<40	<30	<30			<30	<40	<30		
83	100	110	97,7	11,1	220	190	160	190,0	24,5	150	190	100	146,7	36,8	75	65	110	83,3	19,3
1400	1300	1500	1400,0	81,6	2100	2200	2000	2100,0	81,6	2000	2400	1700	2033,3	286,7	1600	1800	2000	1800,0	163,3
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<5	<5	<5			<5	<5	<5			<5	<5	<5			<5	<5	<5		
<30	<30	<30			<30	<30	<30			<40	<30	<30			<30	<40	<30		
<30	<30	<30			32	<30	35			<40	<30	<30			<30	<40	<30		
120	120	110	116,7	4,7	190	170	220	193,3	25,2	140	120	94	118,0	18,8	68	56	96	73,3	16,8
510	510	480	500,0	14,1	730	760	900	796,7	90,7	780	700	640	706,7	57,3	580	550	700	610,0	64,8
358,4	353,7	356,1	356,1	1,9	365,8	347,2	380,7	364,6	16,8	380,2	368,3	355,3	367,9	10,2	357	428,8	437,2	407,7	36,0
1,13	1,14	1,16	1,1	0,0	1,14	1,14	1,12	1,1	0,0	1,14	1,15	1,15	1,1	0,0	1,15	1,13	1,15	1,1	0,0
2,5E+05	1,4E+05	1,6E+05	1,8E+05	5,0E+04	1,3E+05	1,5E+05	3,0E+05	1,9E+05	7,3E+04	6,9E+04	7,5E+04	4,1E+04	6,2E+04	1,5E+04	8,7E+04	8,7E+04	5,8E+04	7,7E+04	1,4E+04

2. Experiment area 2. Sampling 08.01.2018 (wk 10)										2. Experiment area 3. Sampling 19.06.2018 (wk 27)									
2K2A	2K2B	2K2C	Average	Std	2T2A	2T2B	2T2C	Average	Std	2K3A	2K3B	2K3C	Average	Std	2T3A	2T3B	2T3C	Average	Std
0-19	0-26	0-25			0-19	0-24	0-24			0-30	0-30	0-30			0-30	0-30	0-30		
22.1.2018	22.1.2018	22.1.2018	2KA-C2	2TA-C2	22.1.2018	22.1.2018	22.1.2018	2TA-C2	2TA-C2	19.6.2018	19.6.2018	19.6.2018	2KA-C2	2TA-C2	19.6.2018	19.6.2018	19.6.2018	2KA-C2	2TA-C2
21	21	21	21,0	0,0	22	22	23	22,3	0,5	21	21	20	20,7	0,5	22	22	22	22,0	0,0
13	13	14	13,3	0,5	13	13	13	13,0	0,0	14	13	14	13,7	0,5	13	13	13	13,0	0,0
7,6	7,5	7,5	7,5	0,0	7,1	7,4	7,4	7,3	0,1	7,4	7,4	7,4	7,4	0,0	7,3	7,4	7,4	7,4	0,0
1000	1300	820	1040,0	198,0	940	1000	580	840,0	185,5	2600	2400	2300	2433,3	124,7	1800	2000	2200	2000,0	163,3
290	380	240	303,3	57,9	210	260	140	203,3	49,2	770	680	690	713,3	40,3	430	480	610	506,7	75,9
710	930	580	740,0	144,5	730	750	440	640,0	141,7	1800	1700	1600	1700,0	81,6	1400	1500	1600	1500,0	81,6
5,80	6,40	5,60	5,93	0,34	6,40	5,30	3,50	5,07	1,20	15	13	14	14,00	0,82	9,7	9,2	10	9,63	0,33
0,06	0,10	0,05	0,07	0,02	0,09	0,10	0,05	0,08	0,02	<0.12	<0.12	<0.12	-	-	0,19	<0.12	<0.12	0,19	0,00
0,05	0,05	0,05	0,05	0,00	0,03	0,04	<0,030	0,04	0,00	<0.12	<0.12	<0.12	-	-	<0.12	<0.12	<0.12	-	-
0,09	0,10	0,08	0,09	0,01	0,08	0,05	0,05	0,06	0,02	0,16	0,16	0,13	0,15	0,01	<0.12	<0.12	<0.12	-	-
0,28	0,31	0,29	0,29	0,01	0,35	0,28	0,18	0,27	0,07	0,72	0,61	0,62	0,65	0,05	0,49	0,47	0,5	0,49	0,01
0,33	0,35	0,32	0,33	0,01	0,39	0,29	0,21	0,30	0,07	0,91	0,78	0,85	0,85	0,05	0,6	0,59	0,66	0,62	0,03
0,62	0,74	0,63	0,66	0,05	0,81	0,61	0,39	0,60	0,17	2,2	2	2,1	2,10	0,08	1,5	1,4	1,7	1,53	0,12
0,23	0,22	0,21	0,22	0,01	0,22	0,18	0,14	0,18	0,03	0,52	0,42	0,43	0,46	0,04	0,3	0,35	0,4	0,35	0,04
0,35	0,39	0,36	0,37	0,02	0,40	0,31	0,22	0,31	0,07	1,1	1	0,97	1,02	0,06	0,73	0,79	0,72	0,75	0,03
0,06	0,07	0,05	0,06	0,01	0,06	0,05	0,03	0,05	0,01	0,27	0,25	0,25	0,26	0,01	0,2	0,18	0,19	0,19	0,01
0,67	0,65	0,60	0,64	0,03	0,77	0,60	0,40	0,59	0,15	1,2	1,2	1,2	1,20	0,00	0,87	0,82	0,93	0,87	0,04
1,20	1,30	1,20	1,23	0,05	1,20	1,10	0,71	1,00	0,21	3	2,3	2,7	2,67	0,29	1,8	1,7	1,9	1,80	0,08
0,12	0,17	0,09	0,13	0,03	0,12	0,13	0,07	0,11	0,03	0,25	0,26	0,19	0,23	0,03	0,17	0,16	0,2	0,18	0,02
0,32	0,35	0,31	0,33	0,02	0,36	0,27	0,20	0,28	0,07	0,99	0,82	0,84	0,88	0,08	0,63	0,74	0,65	0,67	0,05
0,33	0,36	0,32	0,34	0,02	0,37	0,30	0,21	0,29	0,07	0,75	0,69	0,7	0,71	0,03	0,47	0,49	0,49	0,48	0,01
0,12	0,16	0,13	0,14	0,02	0,14	0,12	0,08	0,11	0,02	0,19	0,18	0,19	0,19	0,00	0,14	0,12	0,15	0,14	0,01
0,94	1,00	0,95	0,96	0,03	1,00	0,89	0,59	0,8	0,2	2,5	2	2,4	2,3	0,2	1,6	1,4	1,7	1,6	0,1
ok	ok	ok			ok	ok	ok												
ok	ok	ok			ok	ok	ok												
<10	<10	<10			<10	<10	<10												
1700	2200	1400	1766,7	330,0	1600	1600	980	1393,3	292,3										
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5												
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5												
<5	<5	<5			<5	<5	<5												
<50	<50	<50			<40	<50	<50												
84	130	63	92,3	28,0	47	81	<50	64,0	17,0										
900	1300	780	993,3	222,3	930	1000	560	830,0	193,0										
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5												
<0,5	<0,5	<0,5			<0,5	<0,5	<0,5												
<5	<5	<5			<5	<5	<5												
<50	<50	<50			<40	<50	<50												
<50	<50	<50			<40	<50	<50												
94	140	82	105,3	25,0	68	68	<50	68,0	0,0										
340	540	340	406,7	94,3	430	370	230	343,3	83,8										
409,3	359,6	376,6	381,8	20,6	362,1	327,8	342,9	344,3	14,0	379,1	369	388,1	378,7	7,8	351,3	362,9	357,5	357,2	4,7
1,14	1,14	1,12	1,1	0,0	1,15	1,13	1,14	1,1	0,0	1,12	1,12	1,12	1,1	0,0	1,13	1,12	1,13	1,1	0,0
2,2E+05	6,8E+04	4,2E+04	1,1E+05	8,0E+04	8,1E+04	6,5E+04	2,2E+05	1,2E+05	6,9E+04	9,4E+04	1,4E+05	7,8E+04	1,0E+05	2,6E+04	7,7E+04	4,2E+04	9,3E+04	7,1E+04	2,1E+04

3. Experiment area 1. Sampling 20.11.2017 (wk 0)										3. Experiment area 2. Sampling 22.05.2018 (wk 38)									
3KA	3KB	3KC	Average	Std	3TA	3TB	3TC	Average	Std	3K2A	3K2B	3K2C	Average	Std	3T2A	3T2B	3T2C	Average	Std
0-26	0-21	0-25			0-26	0-21	0-25			0-30	0-30	0-30			0-30	0-30	0-30		
20.11.2017	20.11.2017	20.11.2017	3KA-C1	3KA-C1	20.11.2017	20.11.2017	20.11.2017	3TA-C1	3TA-C1	22.5.2018	22.5.2018	22.5.2018	3KA-C2	3KA-C2	22.5.2018	22.5.2018	22.5.2018	3KA-C2	3TA-C2
22	22	21	21,7	0,5	24	24	24	24,0	0,0	21	21	21	21,0	0,0	25	24	25	24,7	0,5
12	12	12	12,0	0,0	11	11	11	11,0	0,0	14	14	14	14,0	0,0	12	12	11	11,7	0,5
7,5	7,3	7,3	7,4	0,1	7,8	7,7	7,6	7,7	0,1	7	6,6	7,1	6,9	0,2	5,3	4,7	4,7	4,9	0,3
860	1300	660	940,0	267,3	750	980	590	773,3	160,1	1900	1800	1500	1733,3	170,0	680	660	580	640,0	43,2
210	270	200	226,7	30,9	170	230	120	173,3	45,0	600	550	440	530,0	66,8	150	140	130	140,0	8,2
650	1000	470	706,7	220,1	580	750	470	600,0	115,2	1300	1300	1100	1233,3	94,3	530	420	440	463,3	47,8
6,70	6,50	4,80	6,00	0,85	6,30	7,70	4,60	6,20	1,27	9,2	9,1	9,8	9,37	0,31	5,3	4,7	4,7	4,90	0,28
0,09	0,11	0,08	0,09	0,01	0,16	0,13	0,10	0,13	0,03	0,18	0,19	0,19	0,19	0,00	0,097	0,057	0,059	0,07	0,02
0,05	0,04	0,03	0,04	0,00	0,04	0,05	0,04	0,04	0,00	0,083	0,067	0,07	0,07	0,01	0,031	0,023	0,027	0,03	0,00
0,10	0,11	0,07	0,09	0,02	0,08	0,10	0,06	0,08	0,02	0,096	0,097	0,092	0,10	0,00	0,045	0,046	0,041	0,04	0,00
0,35	0,33	0,24	0,31	0,05	0,37	0,41	0,26	0,35	0,06	0,44	0,48	0,54	0,49	0,04	0,31	0,26	0,28	0,28	0,02
0,37	0,39	0,27	0,34	0,05	0,40	0,45	0,27	0,37	0,08	0,46	0,52	0,55	0,51	0,04	0,31	0,28	0,3	0,30	0,01
0,75	0,77	0,52	0,68	0,11	0,71	0,87	0,48	0,69	0,16	1,2	1,1	1,3	1,20	0,08	0,68	0,63	0,65	0,65	0,02
0,26	0,23	0,18	0,22	0,03	0,26	0,27	0,18	0,24	0,04	0,28	0,29	0,37	0,31	0,04	0,17	0,16	0,18	0,17	0,01
0,40	0,39	0,27	0,35	0,06	0,35	0,41	0,24	0,33	0,07	0,48	0,62	0,65	0,58	0,07	0,31	0,34	0,33	0,33	0,01
0,07	0,07	0,04	0,06	0,01	0,06	0,07	0,03	0,05	0,02	0,13	0,15	0,16	0,15	0,01	0,086	0,093	0,094	0,09	0,00
0,68	0,74	0,48	0,63	0,11	0,60	0,85	0,46	0,64	0,16	0,99	0,85	0,82	0,89	0,07	0,49	0,44	0,39	0,44	0,04
1,40	1,30	1,00	1,23	0,17	1,30	1,60	0,99	1,30	0,25	2	1,9	2	1,97	0,05	1,1	0,87	0,89	0,95	0,10
0,14	0,14	0,09	0,12	0,03	0,10	0,15	0,08	0,11	0,03	0,18	0,15	0,13	0,15	0,02	0,078	0,07	0,062	0,07	0,01
0,34	0,37	0,25	0,32	0,05	0,33	0,38	0,22	0,31	0,07	0,45	0,51	0,58	0,51	0,05	0,28	0,3	0,29	0,29	0,01
0,34	0,36	0,26	0,32	0,04	0,38	0,41	0,26	0,35	0,06	0,52	0,53	0,58	0,54	0,03	0,31	0,25	0,26	0,27	0,03
0,17	0,17	0,12	0,15	0,02	0,13	0,18	0,10	0,14	0,03	0,14	0,1	0,1	0,11	0,02	0,052	0,032	0,024	0,04	0,01
1,2	1	0,85	1,0	0,1	1,1	1,3	0,8	1,1	0,2	1,7	1,6	1,7	1,7	0,0	0,96	0,82	0,81	0,9	0,1
ok	ok	ok			ok	ok	ok			ok	ok	ok			ok	ok	ok		
ok	ok	ok			ok	ok	ok			ok	ok	ok			ok	ok	ok		
<10	<10	<10			<10	<10	<10			<10	<10	<10			<10	<10	<10		
3200	3200	4100	3500,0	424,3	2300	2400	2000	2233,3	170,0	3600	3600	3100	3433,3	235,7	1400	1100	1200	1233,3	124,7
<0,50	<0,50	<0,50			<0,50	<0,50	<0,50			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<0,50	<0,50	<0,50			<0,50	<0,50	<0,50			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<5,0	<5,0	<5,0			<5,0	<5,0	<5,0			<5	<5	<5			<5	<5	<5		
<50	<50	<50			<40	<40	<50			26	<20	<20	26,0	0,0	<20	<20	<20		
87	78	150	105,0	32,0	67	85	58	70,0	11,2	240	180	130	183,3	45,0	46	36	35	39,0	5,0
1600	1700	2300	1866,7	309,1	1200	1600	1200	1333,3	188,6	1600	1500	1300	1466,7	124,7	660	440	490	530,0	94,2
<0,50	<0,50	<0,50			<0,50	<0,50	<0,50			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<0,50	<0,50	<0,50			<0,50	<0,50	<0,50			<0,5	<0,5	<0,5			<0,5	<0,5	<0,5		
<5,0	<5,0	<5,0			<5,0	<5,0	<5,0			<5	<5	<5			<5	<5	<5		
<50	<50	<50			<40	<40	<50			<20	<20	<20			<20	<20	<20		
<50	<50	<50			<40	<40	<50			36	36	<20	36,0	0,0	<20	<20	<20		
100	55	150	101,7	38,8	76	82	52	70,0	13,0	180	210	130	173,3	33,0	50	48	49	49,0	0,8
490	380	700	523,3	132,7	390	440	310	380,0	53,5	560	700	510	590,0	80,4	250	240	250	246,7	4,7
337,8	328,3	367,7	344,6	16,8	297,9	308,1	289	298,3	7,8	358,9	361,6	355,6	358,7	2,5	295,9	297,4	301,3	298,2	2,3
1,15	1,12	1,14	1,1	0,0	1,18	1,13	1,18	1,2	0,0	1,11	1,12	1,12	1,1	0,0	1,12	1,15	1,15	1,1	0,0
9,1E+04	7,5E+04	1,1E+05	93731,6	15922,6	1,1E+05	7,3E+04	1,0E+05	9,4E+04	1,5E+04	2,3E+05	1,0E+05	1,2E+05	1,5E+05	5,6E+04	1,1E+05	6,2E+04	1,6E+05	1,1E+05	3,9E+04

3. Experiment area 3. Sampling 13.08.2018 (wk 50)																				
3K3A	3K3B	3K3C			3T3A	3T3B	3T3C													
13.8.2018	13.8.2018	13.8.2018			13.8.2018	13.8.2018	13.8.2018													

Certificate

Project: 170194/1

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Sample information: Lamor Corporation Ab, sediment samples X1131 Grace WP2

Date of sampling: 14.8.2017
Date of arrival: 15.8.2017
Sampling by: Research started: 15.8.2017

Sediment samples

						Unit	Method	
Sampling point	OIA 0--30	OIA 30--35	OIB 0-30	OIB 30--33	OIC 0-30			
Sample ID	17MS 00116	17MS 00117	17MS 00118	17MS 00119	17MS 00120			
Dry matter	21	28	21	28	23	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	13	9,8	13	9,3	13	% dw	EF4016	L
pH	7,7	8,3	7,9	8,4	8,0		EF2036	L
Petroleum hydrocarbons (C10-C40)			1300	130		mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)			390	<40		mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)			930	96		mg/kg dw	EF4020[1]	L
PAH16 sum	12	2,7	11	1,5	7,3	mg/kg dw	EF4020A[1]	L
Anthracene	0,36	0,084	0,33	0,039	0,21	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,17	0,053	0,12	0,031	0,072	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,16	0,017	0,13	0,011	0,086	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,58	0,16	0,56	0,096	0,40	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,54	0,13	0,57	0,084	0,38	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	1,2	0,23	1,1	0,14	0,74	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,39	0,067	0,36	0,047	0,23	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,61	0,13	0,60	0,076	0,39	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,11	0,022	0,11	0,012	0,071	mg/kg dw	EF4020A[1]	L
Phenanthrene	1,2	0,20	0,96	0,11	0,66	mg/kg dw	EF4020A[1]	L
Fluoranthene	2,7	0,69	2,4	0,36	1,7	mg/kg dw	EF4020A[1]	L
Fluorene	0,29	0,077	0,20	0,036	0,13	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,53	0,12	0,53	0,069	0,35	mg/kg dw	EF4020A[1]	L
Chrysene	0,66	0,17	0,56	0,092	0,39	mg/kg dw	EF4020A[1]	L
Naphthalene	0,29	0,028	0,23	0,017	0,15	mg/kg dw	EF4020A[1]	L
Pyrene	2,2	0,54	2,0	0,30	1,4	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	ok	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	ok	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	3700	370	2800	200	1600	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	<20	<30	<20	<30	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	180	<20	98	<20	58	mg/kg dw	EF4020D[1]	L

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	17MS 00116	17MS 00117	17MS 00118	17MS 00119	17MS 00120	Unit	Method	
Aliphatic hydrocarbons >C16-C35	1900	240	1200	96	840	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbonsC6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	<20	<30	<20	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<30	<20	<30	<20	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	170	<20	110	<20	66	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	530	68	430	28	270	mg/kg dw	EF4020D[1]	L
Water content	373,7	254,9	363,6	242,9	361,7	w%		L
Bulk density	1,15	1,20	1,13	1,22	1,15		CEN ISO/TS 17892-2	L

Sediment samples

						Unit	Method	
Sampling point	OIC 30--35	O2A 0--30	O2A 30-34	O2B 0--30	O2B 30-40			
Sample ID	17MS 00121	17MS 00122	17MS 00123	17MS 00124	17MS 00125			
Dry matter	28	21	25	19	25	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	10	14	11	15	11	% dw	EF4016	L
pH	8,3	7,5	8,0	7,6	8,1		EF2036	L
Petroleum hydrocarbons (C10-C40)				2300	340	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)				760	100	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)				1600	240	mg/kg dw	EF4020[1]	L
PAH16 sum	1,3	11	6,8	13	5,0	mg/kg dw	EF4020A[1]	L
Anthracene	0,035	0,29	0,20	0,40	0,13	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,026	0,095	0,081	0,15	0,066	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,009	0,15	0,057	0,19	0,040	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,079	0,56	0,41	0,65	0,29	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,067	0,57	0,37	0,64	0,25	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,12	1,1	0,67	1,2	0,47	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,036	0,36	0,21	0,40	0,15	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,064	0,59	0,37	0,66	0,25	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,011	0,11	0,067	0,12	0,045	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,11	1,0	0,44	1,3	0,42	mg/kg dw	EF4020A[1]	L
Fluoranthene	0,31	2,3	1,6	2,8	1,2	mg/kg dw	EF4020A[1]	L
Fluorene	0,030	0,22	0,11	0,32	0,089	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,058	0,52	0,33	0,59	0,22	mg/kg dw	EF4020A[1]	L
Chrysene	0,080	0,57	0,44	0,69	0,34	mg/kg dw	EF4020A[1]	L
Naphthalene	0,015	0,26	0,088	0,33	0,071	mg/kg dw	EF4020A[1]	L
Pyrene	0,25	1,9	1,3	2,3	0,98	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	ok	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	ok	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	170	3000	990	4300	580	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<20	<30	<20	<30	<20	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	<20	140	34	240	24	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons >C16-C35	92	1700	510	2300	330	mg/kg dw	EF4020D[1]	L

The results apply solely to the samples analyzed. The certificate may only be copied as whole.

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	17MS 00121	17MS 00122	17MS 00123	17MS 00124	17MS 00125	Unit	Method	
Aromatic hydrocarbonsC6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<20	<30	<20	<30	<20	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<20	<30	<20	45	<20	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	<20	130	51	230	35	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	24	530	180	760	110	mg/kg dw	EF4020D[1]	L
Water content	264,3	362,5	297,2	391,1	296,4	w%		L
Bulk density	1,19	1,14	1,18	1,13	1,17		CEN ISO/TS 17892-2	L

Sediment samples

	O2C 0--30	O2C 30-37	Unit	Method	
Sampling point					
Sample ID	17MS 00126	17MS 00127			
Dry matter	22	28	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	13	9,4	% dw	EF4016	L
pH	7,6	8,2		EF2036	L
Petroleum hydrocarbons (C10-C40)			mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)			mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)			mg/kg dw	EF4020[1]	L
PAH16 sum	7,8	1,4	mg/kg dw	EF4020A[1]	L
Anthracene	0,19	0,039	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,058	0,028	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,11	0,010	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,42	0,087	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,45	0,074	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,87	0,12	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,27	0,037	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,46	0,068	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,086	0,013	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,74	0,12	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,6	0,31	mg/kg dw	EF4020A[1]	L
Fluorene	0,14	0,033	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,41	0,060	mg/kg dw	EF4020A[1]	L
Chrysene	0,43	0,076	mg/kg dw	EF4020A[1]	L
Naphthalene	0,15	0,017	mg/kg dw	EF4020A[1]	L
Pyrene	1,4	0,26	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	1700	150	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	<20	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	76	<20	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons >C16-C35	1100	87	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbonsC6	<0,5	<0,5	mg/kg dw	EF4049E[1]	L

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	17MS 00126	17MS 00127	Unit	Method	
Aromatic hydrocarbons >C6-C8	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	<20	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<30	<20	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	130	<20	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	570	30	mg/kg dw	EF4020D[1]	L
Water content	344,4	259,9	w%		L
Bulk density	1,15	1,20		CEN ISO/TS 17892-2	L

[1] Method is accredited by the FINAS. Uncertainty of measurement is reported if requested.

Eurofins Environment Testing Finland Oy

Anri Aallonen
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More info Date of sampling: 14.8.2017 and 15.8.2017.

Laboratories L Analyzed in Lahti (FI)

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Description of methods

EF4020 Petroleum hydrocarbons	Petroleum hydrocarbons were determined using GC/FID (ISO 11046 and ISO 16703). The sum of non polar hydrocarbons between C10H22 - C40H82 (decane - tetracontate) were analyzed comparing to light fuel oil (diesel) and lubricant. The normal LOQ is 10 mg/kg and the MU is 31 %.
EF4020A PAH	Polyaromatic hydrocarbons (PAH) were determined after solvent excraction using GC/MS (ISO 18287, SFS-EN 15527 and CEN/TS 16181). The normal LOQ is 0,003 mg/kg dw / compound. The MU is 26-43 %..

Certificate

Project: 170194/2

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Sample information:	Lamor Corporation Ab, sediment samples X1131 Grace WP2		
Reference:	X11131 Grace WP 2	Date of sampling:	16.8.2017
		Date of arrival:	16.8.2017
Sampling by:		Research started:	16.8.2017

Sediment samples

						Unit	Method	
Sampling point	O3A 0--30	O3A 30-34	O3B 0--30	O3B 30-35	O3C 0--30			
Sample ID	17MS 00128	17MS 00129	17MS 00130	17MS 00131	17MS 00132			
Dry matter	21	19	21	19	21	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	14	17	14	16	14	% dw	EF4016	L
pH	7,4	7,6	7,5	7,7	7,3		EF2036	L
Petroleum hydrocarbons (C10-C40)			2100	3000		mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)			690	840		mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)			1400	2100		mg/kg dw	EF4020[1]	L
PAH16 sum	12	32	11	29	11	mg/kg dw	EF4020A[1]	L
Anthracene	0,35	0,92	0,36	0,84	0,33	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,12	0,32	0,14	0,30	0,13	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,14	0,23	0,17	0,24	0,19	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,62	2,2	0,52	1,7	0,55	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,64	1,8	0,52	1,6	0,56	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	1,2	3,2	1,0	2,9	1,1	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,37	1,1	0,32	0,84	0,32	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,66	1,6	0,51	1,6	0,54	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,13	0,36	0,099	0,32	0,11	mg/kg dw	EF4020A[1]	L
Phenanthrene	1,1	3,0	1,1	2,7	1,2	mg/kg dw	EF4020A[1]	L
Fluoranthene	2,5	6,8	2,3	6,3	2,3	mg/kg dw	EF4020A[1]	L
Fluorene	0,23	0,60	0,29	0,57	0,27	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,59	1,6	0,46	1,4	0,49	mg/kg dw	EF4020A[1]	L
Chrysene	0,65	2,4	0,56	2,0	0,59	mg/kg dw	EF4020A[1]	L
Naphthalene	0,22	0,25	0,26	0,61	0,28	mg/kg dw	EF4020A[1]	L
Pyrene	2,0	5,2	1,9	4,9	1,9	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	ok	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	ok	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	2800	6800	3700	5900	3500	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	89	<30	61	<30	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	180	340	240	270	190	mg/kg dw	EF4020D[1]	L

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Certificate

Project: 170194/2

	17MS 00128	17MS 00129	17MS 00130	17MS 00131	17MS 00132	Unit	Method	
Aliphatic hydrocarbons >C16-C35	1800	3800	2200	3100	2000	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbonsC6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	<30	<30	<30	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	39	45	32	40	30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	220	280	190	290	180	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	820	1200	650	1100	660	mg/kg dw	EF4020D[1]	L
Water content	377,1	421,0	376,1	426,7	398,2	w%		L
Bulk density	1,16	1,12	1,15	1,13	1,14		CEN ISO/TS 17892-2	L

Sediment samples

		Unit	Method	
Sampling point	O3C 30-37			
Sample ID	17MS 00133			
Dry matter	17	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	17	% dw	EF4016	L
pH	7,5		EF2036	L
Petroleum hydrocarbons (C10-C40)		mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)		mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)		mg/kg dw	EF4020[1]	L
PAH16 sum	31	mg/kg dw	EF4020A[1]	L
Anthracene	0,90	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,35	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,24	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	2,3	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	1,9	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	3,2	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,99	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	1,6	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,36	mg/kg dw	EF4020A[1]	L
Phenanthrene	2,7	mg/kg dw	EF4020A[1]	L
Fluoranthene	6,7	mg/kg dw	EF4020A[1]	L
Fluorene	0,54	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	1,6	mg/kg dw	EF4020A[1]	L
Chrysene	2,4	mg/kg dw	EF4020A[1]	L
Naphthalene	0,27	mg/kg dw	EF4020A[1]	L
Pyrene	5,3	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	5300	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	66	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	260	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons >C16-C35	2900	mg/kg dw	EF4020D[1]	L

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Project: 170194/2

	17MS 00133	Unit	Method	
Aromatic hydrocarbonsC6	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	41	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	280	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	1200	mg/kg dw	EF4020D[1]	L
Water content	409,2	w%		L
Bulk density	1,13		CEN ISO/TS 17892-2	L

[1] Method is accredited by the FINAS. Uncertainty of measurement is reported if requested.

Eurofins Environment Testing Finland Oy

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Description of methods

EF4020 Petroleum hydrocarbons	Petroleum hydrocarbons were determined using GC/FID (ISO 11046 and ISO 16703). The sum of non polar hydrocarbons between C10H22 - C40H82 (decane - tetracontate) were analyzed comparing to light fuel oil (diesel) and lubricant. The normal LOQ is 10 mg/kg and the MU is 31 %.
EF4020A PAH	Polyaromatic hydrocarbons (PAH) were determined after solvent excraction using GC/MS (ISO 18287, SFS-EN 15527 and CEN/TS 16181). The normal LOQ is 0,003 mg/kg dw / compound. The MU is 26-43 %..

Certificate

Project: 170194/3

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Sample information: Lamor Corporation Ab, sediment samples, X1131 Grace WP2

Date of sampling: 28.8.2017
Date of arrival: 29.8.2017
Sampling by: Research started: 29.8.2017

Sediment samples

						Unit	Method	
Sampling point	I1KA 0--30	I1KB 0--30	I1HC 0--30	I1TA 0--30	I1TB 0--30			
Sample ID	17MS 00149	17MS 00150	17MS 00151	17MS 00152	17MS 00153			
Dry matter	23	22	21	21	20	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	13	13	12	14	14	% dw	EF4016	L
pH	7,6	7,6	7,5	7,6	7,5		EF2036	L
Petroleum hydrocarbons (C10-C40)		780			1900	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)		200			540	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)		570			1300	mg/kg dw	EF4020[1]	L
PAH16 sum	7,8	7,2	5,9	9,1	8,4	mg/kg dw	EF4020A[1]	L
Anthracene	0,23	0,21	0,18	0,29	0,28	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,11	0,10	0,079	0,18	0,16	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,12	0,10	0,090	0,16	0,19	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,37	0,34	0,29	0,40	0,37	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,38	0,35	0,30	0,41	0,36	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,67	0,60	0,50	0,72	0,67	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,18	0,18	0,15	0,20	0,19	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,41	0,37	0,31	0,41	0,38	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,057	0,055	0,045	0,061	0,050	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,84	0,76	0,66	1,0	1,0	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,8	1,7	1,4	2,1	1,9	mg/kg dw	EF4020A[1]	L
Fluorene	0,18	0,16	0,14	0,31	0,27	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,42	0,38	0,32	0,43	0,38	mg/kg dw	EF4020A[1]	L
Chrysene	0,34	0,33	0,25	0,38	0,34	mg/kg dw	EF4020A[1]	L
Naphthalene	0,24	0,23	0,16	0,30	0,27	mg/kg dw	EF4020A[1]	L
Pyrene	1,4	1,4	1,1	1,7	1,5	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	ok	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	ok	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	2200	1600	1500	3300	3600	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	<30	<30	<30	<30	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	84	66	46	200	210	mg/kg dw	EF4020D[1]	L

Certificate

Project: 170194/3

	17MS 00149	17MS 00150	17MS 00151	17MS 00152	17MS 00153	Unit	Method	
Aliphatic hydrocarbons >C16-C35	1300	870	780	2000	2000	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbonsC6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	<30	<30	<30	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<30	<30	<30	<30	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	100	60	44	120	120	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	470	240	230	410	440	mg/kg dw	EF4020D[1]	L
Water content	347,9	357,8	331,0	404,8	364,8	w%		L
Bulk density	Liite	Liite	Liite	Liite	Liite		CEN ISO/TS 17892-2	L

Sediment samples

		Unit	Method	
Sampling point	I1TC 0--30			
Sample ID	17MS 00154			
Dry matter	21	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	14	% dw	EF4016	L
pH	7,5		EF2036	L
Petroleum hydrocarbons (C10-C40)		mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)		mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)		mg/kg dw	EF4020[1]	L
PAH16 sum	7,1	mg/kg dw	EF4020A[1]	L
Anthracene	0,22	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,15	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,15	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,30	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,33	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,59	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,17	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,34	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,049	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,87	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,6	mg/kg dw	EF4020A[1]	L
Fluorene	0,24	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,36	mg/kg dw	EF4020A[1]	L
Chrysene	0,26	mg/kg dw	EF4020A[1]	L
Naphthalene	0,23	mg/kg dw	EF4020A[1]	L
Pyrene	1,3	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	2900	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	170	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons >C16-C35	1500	mg/kg dw	EF4020D[1]	L

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	17MS 00154	Unit	Method	
Aromatic hydrocarbonsC6	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	110	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	420	mg/kg dw	EF4020D[1]	L
Water content	370,2	w%		L
Bulk density	Liite		CEN ISO/TS 17892-2	L

[1] Method is accredited by the FINAS. Uncertainty of measurement is reported if requested.

Eurofins Environment Testing Finland Oy

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Description of methods

EF4020 Petroleum hydrocarbons	Petroleum hydrocarbons were determined using GC/FID (ISO 11046 and ISO 16703). The sum of non polar hydrocarbons between C10H22 - C40H82 (decane - tetracontate) were analyzed comparing to light fuel oil (diesel) and lubricant. The normal LOQ is 10 mg/kg and the MU is 31 %.
EF4020A PAH	Polyaromatic hydrocarbons (PAH) were determined after solvent excraction using GC/MS (ISO 18287, SFS-EN 15527 and CEN/TS 16181). The normal LOQ is 0,003 mg/kg dw / compound. The MU is 26-43 %..

Certificate

Project: 170194/4

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Sample information:	Lamor Corporation Ab, sediment samples, X1131 Grace WP2		
Reference:	X1131 Grace WP2	Date of sampling:	9.10.2017
		Date of arrival:	9.10.2017
Sampling by:		Research started:	9.10.2017

Sediment samples

						Unit	Method	
Sampling point	ITA2 0--30	ITB2 0--30	ITC2 0--30	IKA2 0--30	IKB2 0--30			
Sample ID	17MS 00196	17MS 00197	17MS 00198	17MS 00199	17MS 00200			
Dry matter	22	21	20	21	22	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	13	13	14	11	11	% dw	EF4016	L
pH	7,4	7,5	7,3	7,9	7,3		EF2036	L
Petroleum hydrocarbons (C10-C40)	1600	1400	1200	480	700	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	550	440	340	110	170	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	1000	980	810	370	530	mg/kg dw	EF4020[1]	L
PAH16 sum	7,5	7,6	7,0	5,7	7,0	mg/kg dw	EF4020A[1]	L
Anthracene	0,16	0,17	0,16	0,13	0,19	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,089	0,096	0,069	0,045	0,047	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,11	0,13	0,10	0,071	0,10	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,37	0,38	0,36	0,31	0,43	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,35	0,34	0,36	0,30	0,40	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,71	0,70	0,70	0,56	0,77	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,21	0,21	0,21	0,16	0,22	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,33	0,32	0,33	0,27	0,38	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,067	0,062	0,061	0,053	0,070	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,92	0,92	0,85	0,73	0,69	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,6	1,7	1,5	1,2	1,5	mg/kg dw	EF4020A[1]	L
Fluorene	0,27	0,26	0,21	0,12	0,13	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,33	0,32	0,34	0,27	0,39	mg/kg dw	EF4020A[1]	L
Chrysene	0,35	0,37	0,34	0,31	0,34	mg/kg dw	EF4020A[1]	L
Naphthalene	0,26	0,29	0,24	0,15	0,16	mg/kg dw	EF4020A[1]	L
Pyrene	1,3	1,4	1,2	1,0	1,2	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	ok	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	ok	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	2800	2600	2000	890	1400	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	<30	<30	<30	<30	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	190	150	98	<30	39	mg/kg dw	EF4020D[1]	L

The results apply solely to the samples analyzed. The certificate may only be copied as whole.

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	17MS 00196	17MS 00197	17MS 00198	17MS 00199	17MS 00200	Unit	Method	
Aliphatic hydrocarbons >C16-C35	1600	1500	1100	480	740	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbonsC6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	<30	<30	<30	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	31	<30	<30	<30	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	130	110	87	31	52	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	420	380	340	150	240	mg/kg dw	EF4020D[1]	L
Water content	380,2	366,4	382,4	289,9	368,2	w%		L
Bulk density	1,09	1,11	1,12	1,18	1,13		CEN ISO/TS 17892-2	L

Sediment samples

		Unit	Method	
Sampling point	IKC2 0--30			
Sample ID	17MS 00201			
Dry matter	20	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	13	% dw	EF4016	L
pH	7,2		EF2036	L
Petroleum hydrocarbons (C10-C40)	840	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	220	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	630	mg/kg dw	EF4020[1]	L
PAH16 sum	9,3	mg/kg dw	EF4020A[1]	L
Anthracene	0,19	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,067	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,14	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,51	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,49	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,91	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,30	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,45	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,088	mg/kg dw	EF4020A[1]	L
Phenanthrene	1,2	mg/kg dw	EF4020A[1]	L
Fluoranthene	2,0	mg/kg dw	EF4020A[1]	L
Fluorene	0,19	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,46	mg/kg dw	EF4020A[1]	L
Chrysene	0,46	mg/kg dw	EF4020A[1]	L
Naphthalene	0,25	mg/kg dw	EF4020A[1]	L
Pyrene	1,6	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	1600	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	54	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons >C16-C35	940	mg/kg dw	EF4020D[1]	L

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Project: 170194/4

	17MS 00201	Unit	Method	
Aromatic hydrocarbonsC6	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	79	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	350	mg/kg dw	EF4020D[1]	L
Water content	355,2	w%		L
Bulk density	1,13		CEN ISO/TS 17892-2	L

[1] Method is accredited by the FINAS. Uncertainty of measurement is reported if requested.

Eurofins Environment Testing Finland Oy

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More info The unit of Bulk density is kg/dm3

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Description of methods

EF4020 Petroleum hydrocarbons	Petroleum hydrocarbons were determined using GC/FID (ISO 11046 and ISO 16703). The sum of non polar hydrocarbons between C10H22 - C40H82 (decane - tetracontate) were analyzed comparing to light fuel oil (diesel) and lubricant. The normal LOQ is 10 mg/kg and the MU is 31 %.
EF4020A PAH	Polyaromatic hydrocarbons (PAH) were determined after solvent excraction using GC/MS (ISO 18287, SFS-EN 15527 and CEN/TS 16181). The normal LOQ is 0,003 mg/kg dw / compound. The MU is 26-43 %..

Certificate

Project: 170194/5

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Sample information:	Lamor Corporation Ab, sediment samples, X1131 Grace WP2		
Reference:	X1131 Grace WP2	Date of sampling:	30.10.2017
		Date of arrival:	30.10.2017
Sampling by:		Research started:	30.10.2017

Sediment samples

						Unit	Method	
Sampling point	II1TA 0--30	II1TB 0--30	II1TC 0--30	II1KA 0--30	II1KB 0--30			
Sample ID	17MS 00213	17MS 00214	17MS 00215	17MS 00216	17MS 00217			
Dry matter	22	18	23	21	22	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	13	13	13	13	13	% dw	EF4016	L
pH	7,7	7,3	7,3	7,3	7,3		EF2036	L
Petroleum hydrocarbons (C10-C40)	1200	940	1800	2100	2100	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	250	190	370	520	560	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	980	750	1400	1600	1500	mg/kg dw	EF4020[1]	L
PAH16 sum	7,1	6,9	7,4	10	8,9	mg/kg dw	EF4020A[1]	L
Anthracene	0,16	0,19	0,21	0,23	0,23	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,055	0,040	0,064	0,12	0,10	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,093	0,087	0,11	0,15	0,14	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,37	0,42	0,38	0,53	0,45	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,40	0,43	0,41	0,55	0,45	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,79	0,80	0,79	1,0	0,90	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,25	0,25	0,23	0,31	0,27	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,39	0,41	0,39	0,54	0,40	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,074	0,077	0,072	0,089	0,076	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,80	0,80	0,84	1,1	1,1	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,4	1,3	1,5	2,3	1,9	mg/kg dw	EF4020A[1]	L
Fluorene	0,15	0,13	0,18	0,25	0,27	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,39	0,42	0,40	0,54	0,43	mg/kg dw	EF4020A[1]	L
Chrysene	0,37	0,32	0,33	0,50	0,36	mg/kg dw	EF4020A[1]	L
Naphthalene	0,18	0,17	0,20	0,31	0,30	mg/kg dw	EF4020A[1]	L
Pyrene	1,2	1,1	1,2	1,9	1,5	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	ok	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	ok	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	3000	2900	3400	4100	4100	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	<40	<30	<40	<30	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	75	65	110	150	190	mg/kg dw	EF4020D[1]	L

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Certificate

Project: 170194/5

	17MS 00213	17MS 00214	17MS 00215	17MS 00216	17MS 00217	Unit	Method	
Aliphatic hydrocarbons >C16-C35	1600	1800	2000	2000	2400	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbonsC6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	<40	<30	<40	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<30	<40	<30	<40	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	68	56	96	140	120	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	580	550	700	780	700	mg/kg dw	EF4020D[1]	L
Water content	357,0	428,8	437,2	380,2	368,3	w%		L
Bulk density	1,15	1,13	1,15	1,14	1,15		CEN ISO/TS 17892-2	L

Sediment samples

		Unit	Method	
Sampling point	II1KC 0--30			
Sample ID	17MS 00218			
Dry matter	22	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	13	% dw	EF4016	L
pH	7,1		EF2036	L
Petroleum hydrocarbons (C10-C40)	1200	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	240	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	930	mg/kg dw	EF4020[1]	L
PAH16 sum	8,2	mg/kg dw	EF4020A[1]	L
Anthracene	0,16	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,058	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,12	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,46	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,48	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,98	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,26	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,43	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,091	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,99	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,6	mg/kg dw	EF4020A[1]	L
Fluorene	0,17	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,46	mg/kg dw	EF4020A[1]	L
Chrysene	0,44	mg/kg dw	EF4020A[1]	L
Naphthalene	0,21	mg/kg dw	EF4020A[1]	L
Pyrene	1,3	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	3600	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	100	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons >C16-C35	1700	mg/kg dw	EF4020D[1]	L

The results apply solely to the samples analyzed. The certificate may only be copied as whole.

Certificate

Project: 170194/5

	17MS 00218	Unit	Method	
Aromatic hydrocarbonsC6	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	94	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	640	mg/kg dw	EF4020D[1]	L
Water content	355,3	w%		L
Bulk density	1,15		CEN ISO/TS 17892-2	L

[1] Method is accredited by the FINAS. Uncertainty of measurement is reported if requested.

Eurofins Environment Testing Finland Oy

Anri Aallonen
M.Sc., Chemist, +358 50 434 4099

More info The unit of Bulk density is kg/dm3

Laboratories L Analyzed in Lahti (FI)

Delivery miikka.tunturi@lamor.com; ossi.tonteri@ymparisto.fi

Description of methods

EF4020 Petroleum hydrocarbons	Petroleum hydrocarbons were determined using GC/FID (ISO 11046 and ISO 16703). The sum of non polar hydrocarbons between C10H22 - C40H82 (decane - tetracontate) were analyzed comparing to light fuel oil (diesel) and lubricant. The normal LOQ is 10 mg/kg and the MU is 31 %.
EF4020A PAH	Polyaromatic hydrocarbons (PAH) were determined after solvent excraction using GC/MS (ISO 18287, SFS-EN 15527 and CEN/TS 16181). The normal LOQ is 0,003 mg/kg dw / compound. The MU is 26-43 %..

Certificate

Project: 170194/6

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Sample information: Lamor Corporation Ab, sediment samples, X1131 Grace WP2

Date of sampling: 20.11.2017
Date of arrival: 21.11.2017
Sampling by: Research started: 21.11.2017

Sediment samples

						Unit	Method	
Sampling point	III1TA 0-30	III1TB 0-30	III1TC 0-30	III1KA 0-30	III1KB 0-30			
Sample ID	17MS 00248	17MS 00249	17MS 00250	17MS 00251	17MS 00252			
Dry matter	24	24	24	22	22	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	11	11	11	12	12	% dw	EF4016	L
pH	7,8	7,7	7,6	7,5	7,3		EF2036	L
Petroleum hydrocarbons (C10-C40)	750	980	590	860	1300	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	170	230	120	210	270	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	580	750	470	650	1000	mg/kg dw	EF4020[1]	L
PAH16 sum	6,3	7,7	4,6	6,7	6,5	mg/kg dw	EF4020A[1]	L
Anthracene	0,16	0,13	0,096	0,089	0,11	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,037	0,047	0,036	0,045	0,038	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,082	0,10	0,060	0,096	0,11	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,37	0,41	0,26	0,35	0,33	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,40	0,45	0,27	0,37	0,39	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,71	0,87	0,48	0,75	0,77	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,26	0,27	0,18	0,26	0,23	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,35	0,41	0,24	0,40	0,39	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,055	0,071	0,033	0,065	0,070	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,60	0,85	0,46	0,68	0,74	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,3	1,6	0,99	1,4	1,3	mg/kg dw	EF4020A[1]	L
Fluorene	0,095	0,15	0,083	0,14	0,14	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,33	0,38	0,22	0,34	0,37	mg/kg dw	EF4020A[1]	L
Chrysene	0,38	0,41	0,26	0,34	0,36	mg/kg dw	EF4020A[1]	L
Naphthalene	0,13	0,18	0,10	0,17	0,17	mg/kg dw	EF4020A[1]	L
Pyrene	1,1	1,3	0,80	1,2	1,0	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	ok	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	ok	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	2300	2400	2000	3200	3200	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,50	<0,50	<0,50	<0,50	<0,50	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,50	<0,50	<0,50	<0,50	<0,50	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5,0	<5,0	<5,0	<5,0	<5,0	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<40	<40	<50	<50	<50	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	67	85	58	87	78	mg/kg dw	EF4020D[1]	L

Certificate

Project: 170194/6

	17MS 00248	17MS 00249	17MS 00250	17MS 00251	17MS 00252	Unit	Method	
Aliphatic hydrocarbons >C16-C35	1200	1600	1200	1600	1700	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbonsC6	<0,50	<0,50	<0,50	<0,50	<0,50	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,50	<0,50	<0,50	<0,50	<0,50	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5,0	<5,0	<5,0	<5,0	<5,0	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<40	<40	<50	<50	<50	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<40	<40	<50	<50	<50	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	76	82	52	100	55	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	390	440	310	490	380	mg/kg dw	EF4020D[1]	L
Water content	297,9	308,1	289,0	337,8	328,3	w%		L
Bulk density	1,18	1,13	1,18	1,15	1,12		CEN ISO/TS 17892-2	L

Sediment samples

		Unit	Method	
Sampling point	II1KC 0--30			
Sample ID	17MS 00253			
Dry matter	21	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	12	% dw	EF4016	L
pH	7,3		EF2036	L
Petroleum hydrocarbons (C10-C40)	660	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	200	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	470	mg/kg dw	EF4020[1]	L
PAH16 sum	4,8	mg/kg dw	EF4020A[1]	L
Anthracene	0,076	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,034	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,071	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,24	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,27	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,52	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,18	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,27	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,041	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,48	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,0	mg/kg dw	EF4020A[1]	L
Fluorene	0,086	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,25	mg/kg dw	EF4020A[1]	L
Chrysene	0,26	mg/kg dw	EF4020A[1]	L
Naphthalene	0,12	mg/kg dw	EF4020A[1]	L
Pyrene	0,85	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	4100	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,50	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,50	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5,0	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<50	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	150	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons >C16-C35	2300	mg/kg dw	EF4020D[1]	L

The results apply solely to the samples analyzed. The certificate may only be copied as whole.

Certificate

Project: 170194/6

	17MS 00253	Unit	Method	
Aromatic hydrocarbonsC6	<0,50	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,50	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5,0	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<50	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<50	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	150	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	700	mg/kg dw	EF4020D[1]	L
Water content	367,7	w%		L
Bulk density	1,14		CEN ISO/TS 17892-2	L

[1] Method is accredited by the FINAS. Uncertainty of measurement is reported if requested.

Eurofins Environment Testing Finland Oy

Anri Aallonen
M.Sc., Chemist, +358 50 434 4099

More info The unit of Bulk density is kg/dm3

Laboratories L Analyzed in Lahti (FI)

Delivery miikka.tunturi@lamor.com; ossi.tonteri@ymparisto.fi

Description of methods

EF4020 Petroleum hydrocarbons	Petroleum hydrocarbons were determined using GC/FID (ISO 11046 and ISO 16703). The sum of non polar hydrocarbons between C10H22 - C40H82 (decane - tetracontate) were analyzed comparing to light fuel oil (diesel) and lubricant. The normal LOQ is 10 mg/kg and the MU is 31 %.
EF4020A PAH	Polyaromatic hydrocarbons (PAH) were determined after solvent excraction using GC/MS (ISO 18287, SFS-EN 15527 and CEN/TS 16181). The normal LOQ is 0,003 mg/kg dw / compound. The MU is 26-43 %..

Tutkimustodistus

Projekti: 170194/6

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Tutkimuksen nimi: Lamor Corporation Ab, sediment samples, X1131 Grace WP2

Näytteenottopvm: 20.11.2017
Näyte saapui: 21.11.2017
Näytteenottaja:
Analysointi aloitettu: 21.11.2017

Sedimenttinäytteet

						Yksikkö	Menetelmä	
Näytteenottopisteet	III1TA 0-30	III1TB 0-30	III1TC 0-30	III1KA 0-30	III1KB 0-30			
Näytenumero	17MS 00248	17MS 00249	17MS 00250	17MS 00251	17MS 00252			
Kuiva-aine	24	24	24	22	22	m-%	EF4016[1]	L
Hehkutushäviö 550°C	11	11	11	12	12	% ka	EF4016	L
pH maa/kiinteä	7,8	7,7	7,6	7,5	7,3		EF2036	L
Öljyhiilivetyjakeet (C10-C40), maa	750	980	590	860	1300	mg/kg ka	EF4020[1]	L
Keskitisleet (C10-C21)	170	230	120	210	270	mg/kg ka	EF4020[1]	L
Raskaat öljyjakeet (C21-C40)	580	750	470	650	1000	mg/kg ka	EF4020[1]	L
PAH, Summa EPA16	6,3	7,7	4,6	6,7	6,5	mg/kg ka	EF4020A[1]	L
Antraseeni	0,16	0,13	0,096	0,089	0,11	mg/kg ka	EF4020A[1]	L
Asenafteeni	0,037	0,047	0,036	0,045	0,038	mg/kg ka	EF4020A[1]	L
Asenaftyleeni	0,082	0,10	0,060	0,096	0,11	mg/kg ka	EF4020A[1]	L
Bentso(a)antraseeni	0,37	0,41	0,26	0,35	0,33	mg/kg ka	EF4020A[1]	L
Bentso(a)pyreeni	0,40	0,45	0,27	0,37	0,39	mg/kg ka	EF4020A[1]	L
Bentso(b+j)fluoranteeni	0,71	0,87	0,48	0,75	0,77	mg/kg ka	EF4020A[1]	L
Bentso(k)fluoranteeni	0,26	0,27	0,18	0,26	0,23	mg/kg ka	EF4020A[1]	L
Bentso(g,h,i)peryleeni	0,35	0,41	0,24	0,40	0,39	mg/kg ka	EF4020A[1]	L
Dibentso(a,h)antraseeni	0,055	0,071	0,033	0,065	0,070	mg/kg ka	EF4020A[1]	L
Fenantreeni	0,60	0,85	0,46	0,68	0,74	mg/kg ka	EF4020A[1]	L
Fluoranteeni	1,3	1,6	0,99	1,4	1,3	mg/kg ka	EF4020A[1]	L
Fluoreeni	0,095	0,15	0,083	0,14	0,14	mg/kg ka	EF4020A[1]	L
Indeno(1,2,3-cd)pyreeni	0,33	0,38	0,22	0,34	0,37	mg/kg ka	EF4020A[1]	L
Kryseeni	0,38	0,41	0,26	0,34	0,36	mg/kg ka	EF4020A[1]	L
Naftaleeni	0,13	0,18	0,10	0,17	0,17	mg/kg ka	EF4020A[1]	L
Pyreeni	1,1	1,3	0,80	1,2	1,0	mg/kg ka	EF4020A[1]	L
Alifaattiset ja Aromaattiset hiilivedyt >C5-C10	ok	ok	ok	ok	ok	mg/kg ka	EF4049E[1]	L
Alifaattiset ja Aromaattiset hiilivedyt >C10-C35	ok	ok	ok	ok	ok	mg/kg ka	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg ka	EF4049E[1]	L
THC >C10-C35	2300	2400	2000	3200	3200	mg/kg ka	EF4020D[1]	L
Alifaattiset C5-C6	<0,50	<0,50	<0,50	<0,50	<0,50	mg/kg ka	EF4049E[1]	L
Alifaattiset >C6-C8	<0,50	<0,50	<0,50	<0,50	<0,50	mg/kg ka	EF4049E[1]	L
Alifaattiset >C8-C10	<5,0	<5,0	<5,0	<5,0	<5,0	mg/kg ka	EF4049E[1]	L
Alifaattiset >C10-C12	<40	<40	<50	<50	<50	mg/kg ka	EF4020D[1]	L
Alifaattiset >C12-C16	67	85	58	87	78	mg/kg ka	EF4020D[1]	L

Tutkimustodistus

Projekti: 170194/6

	17MS 00248	17MS 00249	17MS 00250	17MS 00251	17MS 00252	Yksikkö	Menetelmä	
Alifaattiset >C16-C35	1200	1600	1200	1600	1700	mg/kg ka	EF4020D¹	L
Aromaattiset C6	<0,50	<0,50	<0,50	<0,50	<0,50	mg/kg ka	EF4049E¹	L
Aromaattiset >C6-C8	<0,50	<0,50	<0,50	<0,50	<0,50	mg/kg ka	EF4049E¹	L
Aromaattiset >C8-C10	<5,0	<5,0	<5,0	<5,0	<5,0	mg/kg ka	EF4049E¹	L
Aromaattiset >C10-C12	<40	<40	<50	<50	<50	mg/kg ka	EF4020D¹	L
Aromaattiset >C12-C16	<40	<40	<50	<50	<50	mg/kg ka	EF4020D¹	L
Aromaattiset >C16-C21	76	82	52	100	55	mg/kg ka	EF4020D¹	L
Aromaattiset >C21-C35	390	440	310	490	380	mg/kg ka	EF4020D¹	L
Vesipitoisuuden määritys	297,9	308,1	289,0	337,8	328,3	w%		L
Irtotiheyden määritys	1,18	1,13	1,18	1,15	1,12		CEN ISO/TS 17892-2	L

Sedimenttinäytteet

		Yksikkö	Menetelmä	
Näytteenottopisteet	II1KC 0--30			
Näytenumero	17MS 00253			
Kuiva-aine	21	m-%	EF4016¹	L
Hehkutushäviö 550°C	12	% ka	EF4016	L
pH maa/kiinteä	7,3		EF2036	L
Öljyhiilivetyjakeet (C10-C40), maa	660	mg/kg ka	EF4020¹	L
Keskitisleet (C10-C21)	200	mg/kg ka	EF4020¹	L
Raskaat öljyjakeet (C21-C40)	470	mg/kg ka	EF4020¹	L
PAH, Summa EPA16	4,8	mg/kg ka	EF4020A¹	L
Antraseeni	0,076	mg/kg ka	EF4020A¹	L
Asenafteeni	0,034	mg/kg ka	EF4020A¹	L
Asenaftyleeni	0,071	mg/kg ka	EF4020A¹	L
Bentso(a)antraseeni	0,24	mg/kg ka	EF4020A¹	L
Bentso(a)pyreeni	0,27	mg/kg ka	EF4020A¹	L
Bentso(b+j)fluoranteeni	0,52	mg/kg ka	EF4020A¹	L
Bentso(k)fluoranteeni	0,18	mg/kg ka	EF4020A¹	L
Bentso(g,h,i)peryleeni	0,27	mg/kg ka	EF4020A¹	L
Dibentso(a,h)antraseeni	0,041	mg/kg ka	EF4020A¹	L
Fenantreeni	0,48	mg/kg ka	EF4020A¹	L
Fluoranteeni	1,0	mg/kg ka	EF4020A¹	L
Fluoreeni	0,086	mg/kg ka	EF4020A¹	L
Indeno(1,2,3-cd)pyreeni	0,25	mg/kg ka	EF4020A¹	L
Kryseeni	0,26	mg/kg ka	EF4020A¹	L
Naftaleeni	0,12	mg/kg ka	EF4020A¹	L
Pyreeni	0,85	mg/kg ka	EF4020A¹	L
Alifaattiset ja Aromaattiset hiilivedyt >C5-C10	ok	mg/kg ka	EF4049E¹	L
Alifaattiset ja Aromaattiset hiilivedyt >C10-C35	ok	mg/kg ka	EF4020D¹	L
THC >C5-C10	<10	mg/kg ka	EF4049E¹	L
THC >C10-C35	4100	mg/kg ka	EF4020D¹	L
Alifaattiset C5-C6	<0,50	mg/kg ka	EF4049E¹	L
Alifaattiset >C6-C8	<0,50	mg/kg ka	EF4049E¹	L
Alifaattiset >C8-C10	<5,0	mg/kg ka	EF4049E¹	L
Alifaattiset >C10-C12	<50	mg/kg ka	EF4020D¹	L
Alifaattiset >C12-C16	150	mg/kg ka	EF4020D¹	L
Alifaattiset >C16-C35	2300	mg/kg ka	EF4020D¹	L

Tutkimustodistus

Projekti: 170194/6

	17MS 00253	Yksikkö	Menetelmä	
Aromaattiset C6	<0,50	mg/kg ka	EF4049E[1]	L
Aromaattiset >C6-C8	<0,50	mg/kg ka	EF4049E[1]	L
Aromaattiset >C8-C10	<5,0	mg/kg ka	EF4049E[1]	L
Aromaattiset >C10-C12	<50	mg/kg ka	EF4020D[1]	L
Aromaattiset >C12-C16	<50	mg/kg ka	EF4020D[1]	L
Aromaattiset >C16-C21	150	mg/kg ka	EF4020D[1]	L
Aromaattiset >C21-C35	700	mg/kg ka	EF4020D[1]	L
Vesipitoisuuden määritys	367,7	w%		L
Irtotiheyden määritys	1,14		CEN ISO/TS 17892-2	L

[1] FINAS -akkreditoitu menetelmä. Mittausepävarmuus ilmoitetaan tarvittaessa. Akkreditointi ei koske lausuntoa.

Eurofins Environment Testing Finland Oy

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Lisätiedot The unit of Bulk density is kg/dm3

Laboratoriot L Analysoitu Lahdessa

Jakelu miikka.tunturi@lamor.com; ossi.tonteri@ymparisto.fi

Tutkimustodistus

Projekti: 170194/6

Menetelmien kuvaukset

EF4016 Kuiva-aine	Kuiva-aine (ISO 11465 ja SFS 3008), haihdutusjäännös tai liuenneiden aineiden kokonaismäärä TDS (SFS-EN 15216) määritettiin kuivaamalla tunnettu määrä näytettä 105 °C lämpötilassa ja punnitsemalla jäännös. TDS kuivaus tehtiin suodatuksen jälkeen. Hehkutus tehtiin kuivatusta näytteestä 550 °C lämpötilassa (SFS 3008).
EF4020 Öljyhiilivetyjakeet C10-C40	Öljyhiilivedyt määritettiin asetoni/heksaaniuuton ja florisil-puhdistuksen jälkeen käyttäen GC/FI-tekniikkaa. Menetelmällä määritetään poolittomien hiilivetyjen summa välillä C10H22 - C40H82 (dekaani - tetrakontaani). Menetelmä perustuu standardiohjeisiin ISO 11046 ja ISO 16703. Määritysraja on 10 mg/kg ja mittausepävarmuus 31 %.
EF4020A PAH	PAH-yhdisteet määritettiin uuton ja puhdistuksen jälkeen käyttäen GC/MS-tekniikkaa (ISO 18287, SFS-EN 15527 ja CEN/TS 16181). Määritysraja on 0,003 mg/kg ka / yhdiste. Menetelmässä ei vastata toteamisrajan ja määritysrajan välissä olevia tuloksia. Mittausepävarmuus on 26-43 %. Summa parametrit on laskettu lower bound-arvona (huomioidaan vain määritysrajalla olevat tai sen ylittävät tulokset. Ympäristöhallinnon ohje 6/2014).
EF4020D Alifaattiset ja Aromaattiset hiilivedyt >C10-C35	THC sekä Alifaattiset ja Aromaattiset hiilivedyt välillä >C10-C35 määritettiin GC-FID-tekniikalla uuton jälkeen standardin CEN ISO/TS 16558-2 mukaisesti. THC analyysi eroaa mineraaliöljymäärityksestä siten, että mineraaliöljynäytteelle tehdään lisäksi florisil-puhdistus, jossa poistuvat mm. rasvat ja vahat ym. poolisia yhdisteitä. Alifaattiset ja Aromaattiset hiilivedyt fraktioitiin silikalla. Näiden fraktioiden joukossa häiritseviä komponentteja (mm. kloorattuja liuottimia, ketoneja, alkoholeja, fenoleita, kasvi ja eläinperäisiä rasvoja, ftalaattien estereitä jne) on vähemmän, sillä fraktiointi silikageelillä poistaa niitä. Näytteellä voi siis olla korkea THC-pitoisuus ja pienet fraktio-pitoisuudet, jos näytteessä on paljon muita kuin hiilivety-yhdisteitä. Toisaalta luontaiset hiilivedyt esim. terpeenit ja turpeesta peräisin olevat yhdisteet ovat pieninä pitoisuuksina hankalia erottaa mineraaliöljystä. Määritysraja on 10 mg/kg ka / fraktio ja mittausepävarmuus on 40 %.
EF4049E Alifaattiset ja Aromaattiset hiilivedyt >C5-C10	Alifaattiset ja Aromaattiset hiilivedyt >C5-C10 määritettiin metanolikestävöidystä näytteestä käyttäen HS/GC/MS-tekniikkaa (mod. ISO 16558-1). Määritysrajat ovat seuraavat: Alifaattiset C5-C6 0,1 mg/kg ka, Alifaattiset >C6-C8 0,1mg/kg ka, Alifaattiset >C8-C10 1,0 mg/kg ka, Aromaattiset C6 0,1 mg/kg ka, Aromaattiset >C6-C8 0,1mg/kg ka sekä Aromaattiset >C8-C10 1,0 mg/kg ka, Mittausepävarmuus on 40 %.

Certificate

Project: 170194/7

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Sample information: Lamor Corporation Ab, sediment samples, X1131 Grace WP2

Date of sampling: 22.1.2018
Date of arrival: 22.1.2018
Sampling by: Research started: 22.1.2018

Sediment samples

						Unit	Method	
Sampling point	II2TA 0--30	II2TB 0--30	II2TC 0--30	II2KA 0--30	II2KB 0--30			
Sample ID	18MS 00005	18MS 00006	18MS 00007	18MS 00008	18MS 00009			
Dry matter	22	22	23	21	21	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	13	13	13	13	13	% dw	EF4016	L
pH	7,1	7,4	7,4	7,6	7,5		EF2036	L
Petroleum hydrocarbons (C10-C40)	940	1000	580	1000	1300	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	210	260	140	290	380	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	730	750	440	710	930	mg/kg dw	EF4020[1]	L
PAH16 sum	6,4	5,3	3,5	5,8	6,4	mg/kg dw	EF4020A[1]	L
Anthracene	0,088	0,10	0,053	0,060	0,10	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,033	0,039	<0,030	0,053	0,054	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,084	0,052	0,047	0,091	0,098	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,35	0,28	0,18	0,28	0,31	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,39	0,29	0,21	0,33	0,35	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,81	0,61	0,39	0,62	0,74	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,22	0,18	0,14	0,23	0,22	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,40	0,31	0,22	0,35	0,39	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,060	0,048	0,034	0,060	0,067	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,77	0,60	0,40	0,67	0,65	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,2	1,1	0,71	1,2	1,3	mg/kg dw	EF4020A[1]	L
Fluorene	0,12	0,13	0,065	0,12	0,17	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,36	0,27	0,20	0,32	0,35	mg/kg dw	EF4020A[1]	L
Chrysene	0,37	0,30	0,21	0,33	0,36	mg/kg dw	EF4020A[1]	L
Naphthalene	0,14	0,12	0,080	0,12	0,16	mg/kg dw	EF4020A[1]	L
Pyrene	1,0	0,89	0,59	0,94	1,0	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	ok	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	ok	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	1600	1600	980	1700	2200	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<40	<50	<50	<50	<50	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	47	81	<50	84	130	mg/kg dw	EF4020D[1]	L

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	18MS 00005	18MS 00006	18MS 00007	18MS 00008	18MS 00009	Unit	Method	
Aliphatic hydrocarbons >C16-C35	930	1000	560	900	1300	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbonsC6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<40	<50	<50	<50	<50	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<40	<50	<50	<50	<50	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	68	68	<50	94	140	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	430	370	230	340	540	mg/kg dw	EF4020D[1]	L
Water content	362,1	327,8	342,9	409,3	359,6	w%		L
Bulk density	1,15	1,13	1,14	1,14	1,14		CEN ISO/TS 17892-2	L

Sediment samples

		Unit	Method	
Sampling point	II2KC 0--30			
Sample ID	18MS 00010			
Dry matter	21	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	14	% dw	EF4016	L
pH	7,5		EF2036	L
Petroleum hydrocarbons (C10-C40)	820	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	240	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	580	mg/kg dw	EF4020[1]	L
PAH16 sum	5,6	mg/kg dw	EF4020A[1]	L
Anthracene	0,049	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,046	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,083	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,29	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,32	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,63	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,21	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,36	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,054	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,60	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,2	mg/kg dw	EF4020A[1]	L
Fluorene	0,091	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,31	mg/kg dw	EF4020A[1]	L
Chrysene	0,32	mg/kg dw	EF4020A[1]	L
Naphthalene	0,13	mg/kg dw	EF4020A[1]	L
Pyrene	0,95	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	1400	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<50	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	63	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons >C16-C35	780	mg/kg dw	EF4020D[1]	L

The results apply solely to the samples analyzed. The certificate may only be copied as whole.

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	18MS 00010	Unit	Method	
Aromatic hydrocarbonsC6	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<50	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<50	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	82	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	340	mg/kg dw	EF4020D[1]	L
Water content	376,6	w%		L
Bulk density	1,12		CEN ISO/TS 17892-2	L

[1] Method is accredited by the FINAS. Uncertainty of measurement is reported if requested.

Eurofins Environment Testing Finland Oy

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More info The unit of Bulk density is kg/dm3

Laboratories L Analyzed in Lahti (FI)

Delivery miikka.tunturi@lamor.com; ossi.tonteri@ymparisto.fi

Description of methods

EF4020 Petroleum hydrocarbons	Petroleum hydrocarbons were determined using GC/FID (ISO 11046 and ISO 16703). The sum of non polar hydrocarbons between C10H22 - C40H82 (decane - tetracontate) were analyzed comparing to light fuel oil (diesel) and lubricant. The normal LOQ is 10 mg/kg and the MU is 31 %.
EF4020A PAH	Polyaromatic hydrocarbons (PAH) were determined after solvent excraction using GC/MS (ISO 18287, SFS-EN 15527 and CEN/TS 16181). The normal LOQ is 0,003 mg/kg dw / compound. The MU is 26-43 %..

Certificate

Project: 170194/8

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Sample information:	Lamor Corporation Ab, sediment samples, X1131 Grace WP2		
Reference:	X1131Grace WP2	Date of sampling:	22.5.2018
		Date of arrival:	22.5.2018
Sampling by:		Research started:	22.5.2018

Sediment samples

						Unit	Method	
Sampling point	III2TA 0-30	III2TB 0-30	III2TC 0-30	III2KA 0-30	III2KB 0-30			
Sample ID	18MS 00156	18MS 00157	18MS 00158	18MS 00159	18MS 00160			
Dry matter	25	24	25	21	21	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	12	12	11	14	14	% dw	EF4016	L
pH	7,1	7,3	7,2	7,0	6,6		EF2036	L
Petroleum hydrocarbons (C10-C40)	680	560	580	1900	1800	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	150	140	130	600	550	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	530	420	440	1300	1300	mg/kg dw	EF4020[1]	L
PAH16 sum	5,3	4,7	4,7	9,2	9,1	mg/kg dw	EF4020A[1]	L
Anthracene	0,097	0,057	0,059	0,18	0,19	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,031	0,023	0,027	0,083	0,067	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,045	0,046	0,041	0,096	0,097	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,31	0,26	0,28	0,44	0,48	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,31	0,28	0,30	0,46	0,52	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	0,68	0,63	0,65	1,2	1,1	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,17	0,16	0,18	0,28	0,29	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,31	0,34	0,33	0,48	0,62	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,086	0,093	0,094	0,13	0,15	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,49	0,44	0,39	0,99	0,85	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,1	0,87	0,89	2,0	1,9	mg/kg dw	EF4020A[1]	L
Fluorene	0,078	0,070	0,062	0,18	0,15	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,28	0,30	0,29	0,45	0,51	mg/kg dw	EF4020A[1]	L
Chrysene	0,31	0,25	0,26	0,52	0,53	mg/kg dw	EF4020A[1]	L
Naphthalene	0,052	0,032	0,024	0,14	0,10	mg/kg dw	EF4020A[1]	L
Pyrene	0,96	0,82	0,81	1,7	1,6	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	ok	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	ok	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	1400	1100	1200	3600	3600	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<20	<20	<20	26	<20	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	46	36	35	240	180	mg/kg dw	EF4020D[1]	L

Certificate

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	18MS 00156	18MS 00157	18MS 00158	18MS 00159	18MS 00160	Unit	Method	
Aliphatic hydrocarbons >C16-C35	660	440	490	1600	1500	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbonsC6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<20	<20	<20	<20	<20	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<20	<20	<20	36	36	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	50	48	49	180	210	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	250	240	250	560	700	mg/kg dw	EF4020D[1]	L
Water content	295,9	297,4	301,3	358,9	361,6	w%		L
Bulk density	1,12	1,15	1,15	1,11	1,12		CEN ISO/TS 17892-2	L

Sediment samples

		Unit	Method	
Sampling point	III2KC 0-30			
Sample ID	18MS 00161			
Dry matter	21	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	14	% dw	EF4016	L
pH	7,1		EF2036	L
Petroleum hydrocarbons (C10-C40)	1500	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	440	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	1100	mg/kg dw	EF4020[1]	L
PAH16 sum	9,8	mg/kg dw	EF4020A[1]	L
Anthracene	0,19	mg/kg dw	EF4020A[1]	L
Acenaphthene	0,070	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,092	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,54	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,55	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	1,3	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,37	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,65	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,16	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,82	mg/kg dw	EF4020A[1]	L
Fluoranthene	2,0	mg/kg dw	EF4020A[1]	L
Fluorene	0,13	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,58	mg/kg dw	EF4020A[1]	L
Chrysene	0,58	mg/kg dw	EF4020A[1]	L
Naphthalene	0,10	mg/kg dw	EF4020A[1]	L
Pyrene	1,7	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	3100	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<20	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	130	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons >C16-C35	1300	mg/kg dw	EF4020D[1]	L

The results apply solely to the samples analyzed. The certificate may only be copied as whole.

Certificate

Project: 170194/8

	18MS 00161	Unit	Method	
Aromatic hydrocarbonsC6	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<20	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<20	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	130	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	510	mg/kg dw	EF4020D[1]	L
Water content	355,6	w%		L
Bulk density	1,12		CEN ISO/TS 17892-2	L

[1] Method is accredited by the FINAS. Uncertainty of measurement is reported if requested.

Eurofins Environment Testing Finland Oy

Anri Aallonen
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More info The unit of Bulk density is kg/dm3

Laboratories L Analyzed in Lahti (FI)

Delivery miikka.tunturi@lamor.com; ossi.tonteri@ymparisto.fi

Description of methods

EF4020 Petroleum hydrocarbons	Petroleum hydrocarbons were determined using GC/FID (ISO 11046 and ISO 16703). The sum of non polar hydrocarbons between C10H22 - C40H82 (decane - tetracontate) were analyzed comparing to light fuel oil (diesel) and lubricant. The normal LOQ is 10 mg/kg and the MU is 31 %.
EF4020A PAH	Polyaromatic hydrocarbons (PAH) were determined after solvent excraction using GC/MS (ISO 18287, SFS-EN 15527 and CEN/TS 16181). The normal LOQ is 0,003 mg/kg dw / compound. The MU is 26-43 %..

Certificate

Project: 170194/9

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Sample information:	Lamor Corporation Ab, sediment samples X1131 Grace WP2		
Reference:	X1131Grace WP2	Date of sampling:	4.6.2018
		Date of arrival:	5.6.2018
Sampling by:		Research started:	5.6.2018

Sediment samples

						Unit	Method	
Sampling point	I3TA 0--30	I3TB 0--30	I3TC 0--30	I3KA 0--30	13KB 0--30			
Sample ID	18MS 00197	18MS 00198	18MS 00199	18MS 00200	18MS 00201			
Dry matter	21	22	22	22	22	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	14	13	13	12	12	% dw	EF4016	L
pH	7,3	7,3	7,4	7,2	7,4		EF2036	L
Petroleum hydrocarbons (C10-C40)	3200	2200	2100	1800	1700	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	920	610	600	480	460	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	2300	1600	1500	1400	1200	mg/kg dw	EF4020[1]	L
PAH16 sum	12	10	11	11	9,9	mg/kg dw	EF4020A[1]	L
Anthracene	0,17	0,28	0,16	0,19	0,15	mg/kg dw	EF4020A[1]	L
Acenaphthene	<0,15	<0,15	<0,15	<0,15	<0,15	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,15	0,13	0,12	0,13	0,11	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,64	0,53	0,59	0,66	0,57	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,71	0,68	0,67	0,71	0,63	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	1,7	1,5	1,6	1,5	1,3	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,51	0,43	0,41	0,42	0,36	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,77	0,60	0,71	0,76	0,64	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,22	0,20	0,20	0,20	0,17	mg/kg dw	EF4020A[1]	L
Phenanthrene	1,0	0,90	0,86	0,88	0,69	mg/kg dw	EF4020A[1]	L
Fluoranthene	2,4	1,7	2,1	2,2	2,0	mg/kg dw	EF4020A[1]	L
Fluorene	0,20	0,14	0,17	0,14	0,11	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,77	0,55	0,69	0,61	0,61	mg/kg dw	EF4020A[1]	L
Chrysene	0,68	0,54	0,60	0,65	0,55	mg/kg dw	EF4020A[1]	L
Naphthalene	0,16	0,13	0,15	0,13	0,10	mg/kg dw	EF4020A[1]	L
Pyrene	2,1	1,6	1,9	2,1	1,8	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	ok	ok	ok	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	ok	ok	ok	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	<10	<10	<10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	4900	5000	3700	3300	3200	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	<30	<30	<30	<30	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	220	190	160	83	100	mg/kg dw	EF4020D[1]	L

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Certificate

Project: 170194/9

	18MS 00197	18MS 00198	18MS 00199	18MS 00200	18MS 00201	Unit	Method	
Aliphatic hydrocarbons >C16-C35	2100	2200	2000	1400	1300	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbonsC6	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	<0,5	<0,5	<0,5	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	<5	<5	<5	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	<30	<30	<30	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	32	<30	35	<30	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	190	170	220	120	120	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	730	760	900	510	510	mg/kg dw	EF4020D[1]	L
Water content	365,8	347,2	380,7	358,4	353,7	w%		L
Bulk density	1,14	1,14	1,12	1,13	1,14		CEN ISO/TS 17892-2	L

Sediment samples

		Unit	Method	
Sampling point	I3KC 0--30			
Sample ID	18MS 00202			
Dry matter	22	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	12	% dw	EF4016	L
pH	7,3		EF2036	L
Petroleum hydrocarbons (C10-C40)	1900	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	490	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	1400	mg/kg dw	EF4020[1]	L
PAH16 sum	9,3	mg/kg dw	EF4020A[1]	L
Anthracene	0,12	mg/kg dw	EF4020A[1]	L
Acenaphthene	<0,15	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,11	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,56	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,61	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	1,2	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,38	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,61	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,18	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,68	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,8	mg/kg dw	EF4020A[1]	L
Fluorene	0,12	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,52	mg/kg dw	EF4020A[1]	L
Chrysene	0,54	mg/kg dw	EF4020A[1]	L
Naphthalene	0,096	mg/kg dw	EF4020A[1]	L
Pyrene	1,8	mg/kg dw	EF4020A[1]	L
Aliphatic and aromatic hydrocarbons >C5-C10	ok	mg/kg dw	EF4049E[1]	L
Aliphatic and aromatic hydrocarbons >C10-C35	ok	mg/kg dw	EF4020D[1]	L
THC >C5-C10	<10	mg/kg dw	EF4049E[1]	L
THC >C10-C35	3100	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons C5-C6	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aliphatic hydrocarbons>C10-C12	<30	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons>C12-C16	110	mg/kg dw	EF4020D[1]	L
Aliphatic hydrocarbons >C16-C35	1500	mg/kg dw	EF4020D[1]	L

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Certificate

Project: 170194/9

	18MS 00202	Unit	Method	
Aromatic hydrocarbonsC6	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C6-C8	<0,5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C8-C10	<5	mg/kg dw	EF4049E[1]	L
Aromatic hydrocarbons >C10-C12	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C12-C16	<30	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C16-C21	110	mg/kg dw	EF4020D[1]	L
Aromatic hydrocarbons >C21-C35	480	mg/kg dw	EF4020D[1]	L
Water content	356,1	w%		L
Bulk density	1,16		CEN ISO/TS 17892-2	L

[1] Method is accredited by the FINAS. Uncertainty of measurement is reported if requested.

Eurofins Environment Testing Finland Oy

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More info The unit of Bulk density is kg/dm3

Laboratories L Analyzed in Lahti (FI)

Delivery miikka.tunturi@lamor.com; ossi.tonteri@ymparisto.fi

Description of methods

EF4020 Petroleum hydrocarbons	Petroleum hydrocarbons were determined using GC/FID (ISO 11046 and ISO 16703). The sum of non polar hydrocarbons between C10H22 - C40H82 (decane - tetracontate) were analyzed comparing to light fuel oil (diesel) and lubricant. The normal LOQ is 10 mg/kg and the MU is 31 %.
EF4020A PAH	Polyaromatic hydrocarbons (PAH) were determined after solvent excraction using GC/MS (ISO 18287, SFS-EN 15527 and CEN/TS 16181). The normal LOQ is 0,003 mg/kg dw / compound. The MU is 26-43 %..

Certificate

Project: 170194/10

Lamor Corporation Ab

Rihkamatori 2
06100 PORVOO

Sample information:	Lamor Corporation Ab, sediment samples X1131 Grace WP2		
Reference:	X1131 Grace WP2	Date of sampling:	18.6.2018
		Date of arrival:	18.6.2018
Sampling by:		Research started:	18.6.2018

Sediment samples

						Unit	Method	
Sampling point	II3TA 0--30	II3TB 0--30	II3TC 0--30	II3KA 0--30	II3KB 0--30			
Sample ID	18MS 00233	18MS 00234	18MS 00235	18MS 00236	18MS 00237			
Dry matter	22	22	22	21	22	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	13	13	13	14	13	% dw	EF4016	L
pH	7,3	7,4	7,4	7,4	7,4		EF2036	L
Petroleum hydrocarbons (C10-C40)	1800	2000	2200	2600	2400	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	430	480	610	770	680	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	1400	1500	1600	1800	1700	mg/kg dw	EF4020[1]	L
PAH16 sum	9,7	9,2	10	15	13	mg/kg dw	EF4020A[1]	L
Anthracene	0,19	<0,12	0,20	0,24	0,25	mg/kg dw	EF4020A[1]	L
Acenaphthene	<0,12	<0,12	<0,12	<0,12	<0,12	mg/kg dw	EF4020A[1]	L
Acenaphthylene	<0,12	<0,12	<0,12	0,16	0,16	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,49	0,47	0,50	0,72	0,61	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,60	0,59	0,66	0,91	0,78	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	1,5	1,4	1,7	2,2	2,0	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,30	0,35	0,40	0,52	0,42	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,73	0,79	0,72	1,1	1,0	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,20	0,18	0,19	0,27	0,25	mg/kg dw	EF4020A[1]	L
Phenanthrene	0,87	0,82	0,93	1,2	1,2	mg/kg dw	EF4020A[1]	L
Fluoranthene	1,8	1,7	1,9	3,0	2,3	mg/kg dw	EF4020A[1]	L
Fluorene	0,17	0,16	0,20	0,25	0,26	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,63	0,74	0,65	0,99	0,82	mg/kg dw	EF4020A[1]	L
Chrysene	0,47	0,49	0,49	0,75	0,69	mg/kg dw	EF4020A[1]	L
Naphthalene	0,14	0,12	0,15	0,19	0,18	mg/kg dw	EF4020A[1]	L
Pyrene	1,6	1,4	1,7	2,5	2,0	mg/kg dw	EF4020A[1]	L
Water content	351,3	362,9	357,5	379,1	369,0	w%		L
Bulk density	1,13	1,12	1,13	1,12	1,12		CEN ISO/TS 17892-2	L

Certificate

Project: 170194/10

Sediment samples

		Unit	Method	
Sampling point	II3KC 0--30			
Sample ID	18MS 00238			
Dry matter	20	m-%	EF4016[1]	L
Loss of ignition (LOI) 550 °C	14	% dw	EF4016	L
pH	7,4		EF2036	L
Petroleum hydrocarbons (C10-C40)	2300	mg/kg dw	EF4020[1]	L
Middle distillates (C10-C21)	690	mg/kg dw	EF4020[1]	L
Heavy hydrocarbon fraction (C21-C40)	1600	mg/kg dw	EF4020[1]	L
PAH16 sum	14	mg/kg dw	EF4020A[1]	L
Anthracene	0,14	mg/kg dw	EF4020A[1]	L
Acenaphthene	<0,12	mg/kg dw	EF4020A[1]	L
Acenaphthylene	0,13	mg/kg dw	EF4020A[1]	L
Benzo(a)anthracene	0,62	mg/kg dw	EF4020A[1]	L
Benzo(a)pyrene	0,85	mg/kg dw	EF4020A[1]	L
Benzo(b+j)fluoranthene	2,1	mg/kg dw	EF4020A[1]	L
Benzo(k)fluoranthene	0,43	mg/kg dw	EF4020A[1]	L
Benzo(g,h,i)perylene	0,97	mg/kg dw	EF4020A[1]	L
Dibenzo(a,h)anthracene	0,25	mg/kg dw	EF4020A[1]	L
Phenanthrene	1,2	mg/kg dw	EF4020A[1]	L
Fluoranthene	2,7	mg/kg dw	EF4020A[1]	L
Fluorene	0,19	mg/kg dw	EF4020A[1]	L
Indeno(1,2,3-c,d)pyrene	0,84	mg/kg dw	EF4020A[1]	L
Chrysene	0,70	mg/kg dw	EF4020A[1]	L
Naphthalene	0,19	mg/kg dw	EF4020A[1]	L
Pyrene	2,4	mg/kg dw	EF4020A[1]	L
Water content	388,1	w%		L
Bulk density	1,12		CEN ISO/TS 17892-2	L

[1] Method is accredited by the FINAS. Uncertainty of measurement is reported if requested.

Eurofins Environment Testing Finland Oy

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More info The unit of Bulk density is kg/dm3

Laboratories L Analyzed in Lahti (FI)

Delivery miikka.tunturi@lamor.com; ossi.tonteri@ymparisto.fi

Description of methods

EF4020 Petroleum hydrocarbons	Petroleum hydrocarbons were determined using GC/FID (ISO 11046 and ISO 16703). The sum of non polar hydrocarbons between C10H22 - C40H82 (decane - tetracontate) were analyzed comparing to light fuel oil (diesel) and lubricant. The normal LOQ is 10 mg/kg and the MU is 31 %.
EF4020A PAH	Polyaromatic hydrocarbons (PAH) were determined after solvent excraction using GC/MS (ISO 18287, SFS-EN 15527 and CEN/TS 16181). The normal LOQ is 0,003 mg/kg dw / compound. The MU is 26-43 %..