SIBELCO EUROPE

Olivine - Environmental Aspects

more from minerals

Curriculum vitae

Jermund Rekkedal

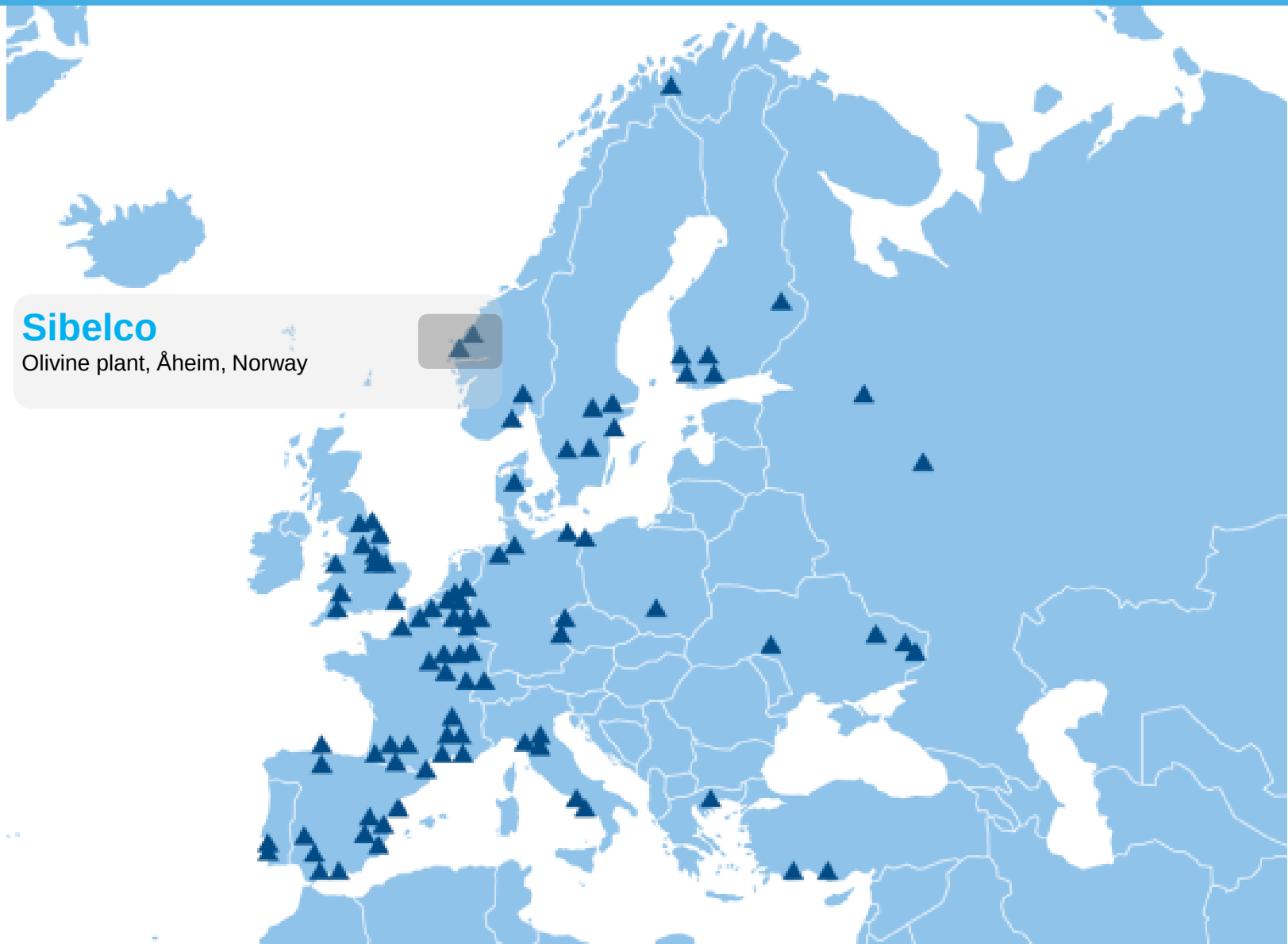
Technical Sales Manager - Water Filtration

Mining Engineer
Norwegian University of Mining, Trondheim 1992
Technology Management - University of Bergen 2008

Employed within Sibelco since 1992 at the Åheim Plant and Lefdal Mine – Norway

- 1992 – 1999 Quality Controll Superintendant Laboratory – Olivine Applications
- 1999 – 2005 Senior RDI Engineer – Olivine Applications Sand
- 2005 – 2008 Mining Manager – Underground Olivine Mine Lefdal
- *2008 – 2012* *Regional Manager of Culture and Youth Ministry* *(sports, music, literature, organizations, festivals etc.)*
- 2012 – 2014 Project Engineer – Enviromental Products
- 2014 – Technical Sales Manager - Water Filtration

Sibelco worldwide



Olivine Mine Gusdal – Åheim(ca.1,5 mia tons tilbage)

What is olivine?

OLIVINE FROM ÅHEIM, NORWAY

$$Mg_{1,85}Fe_{0,14}Ni_{0,01}SiO_4$$

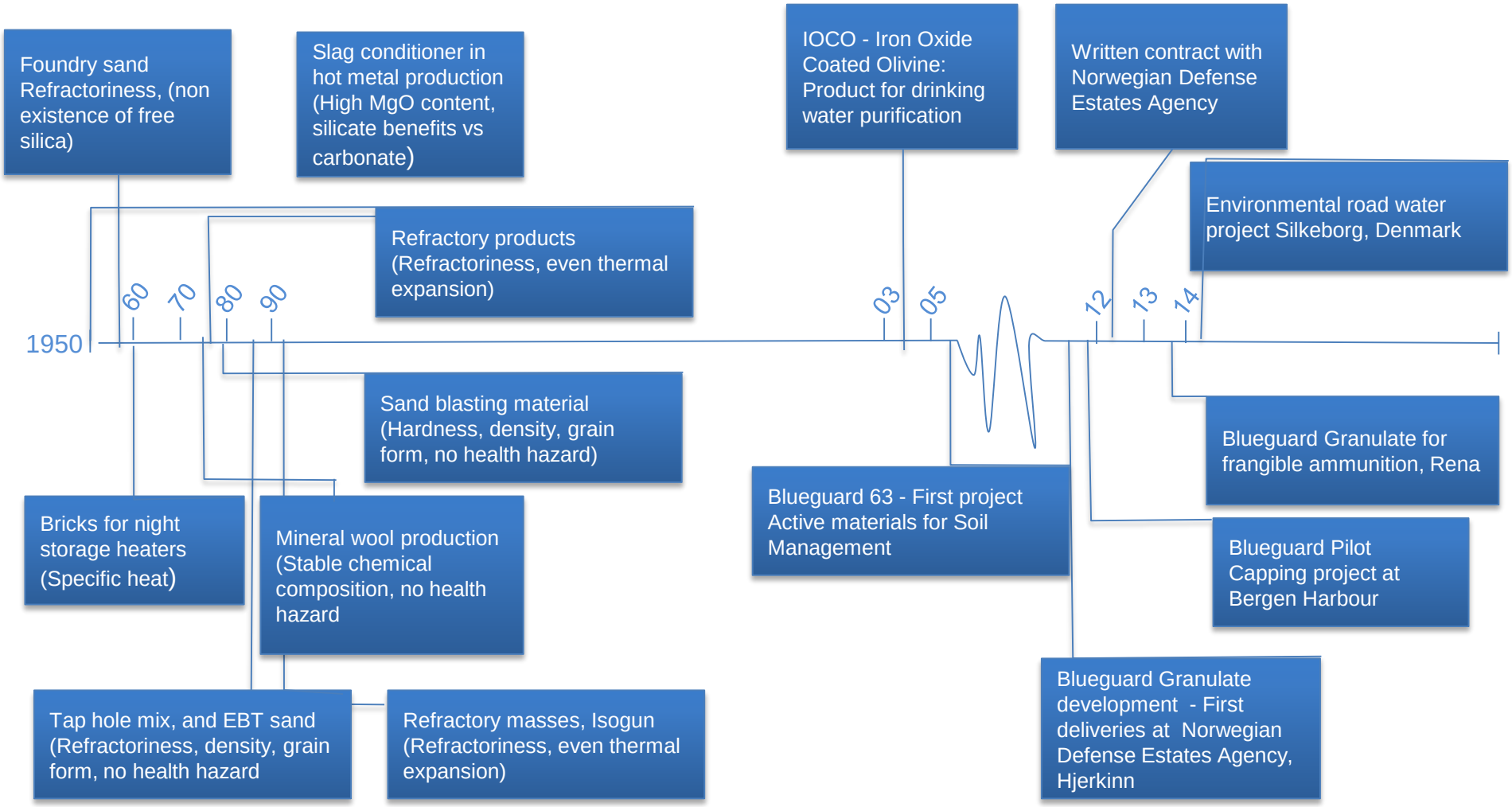
Magnesium iron silicate. Occurs as rock from the earth's mantle. Basic mineral. Oldest rock in Norway (three billion years). Crystalline. Versatile industrial mineral with many uses.

The olivine mineral

The olivine containing rock from Åheim, Norway is among the oldest rocks on earth – new studies indicate the age up to 3000 million years old. The green mineral has a crystalline occurrence and is chemically a very stable mineral.

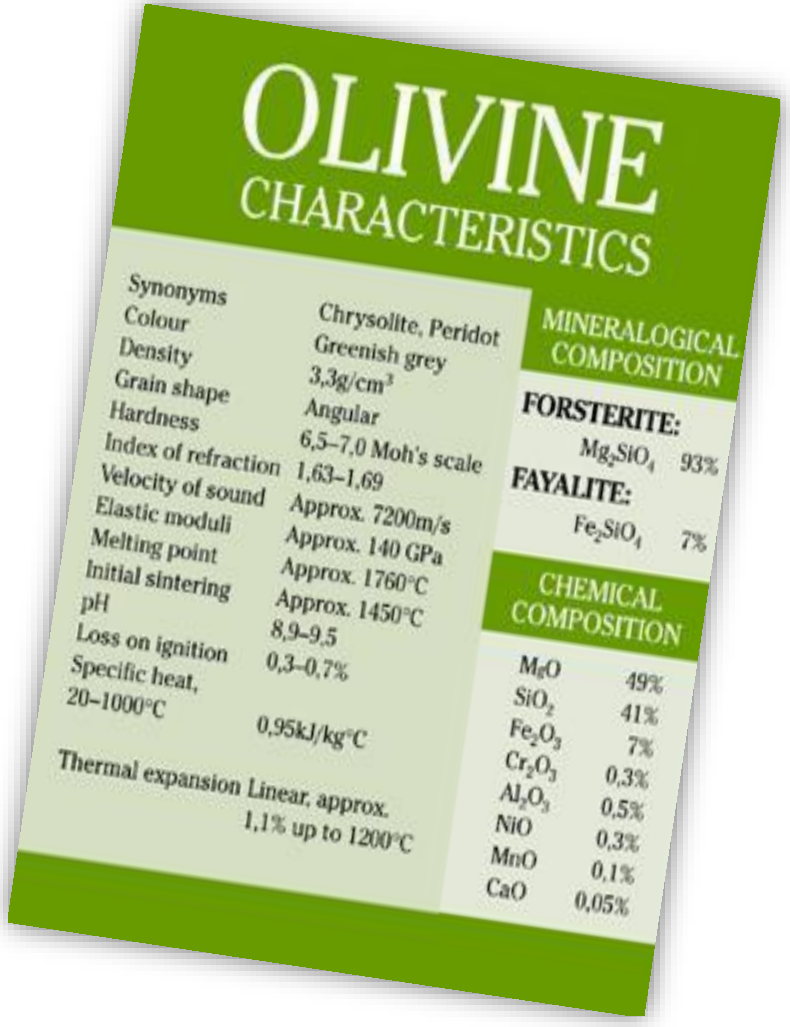
The content of olivine in the rock is 90-95 weight% and the mineral is mainly a magnesium silicate. Crushed olivine has a very reactive surface due to a single tethraeder based lattice. Unlike clay, zeolites etc. olivine will bind the heavy metals much stronger to its surface. This is important to avoid the heavy metals to leak out again at a later stage.

Historic - Environmental Olivine products



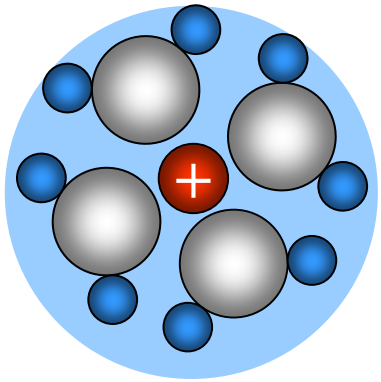
Environmental properties

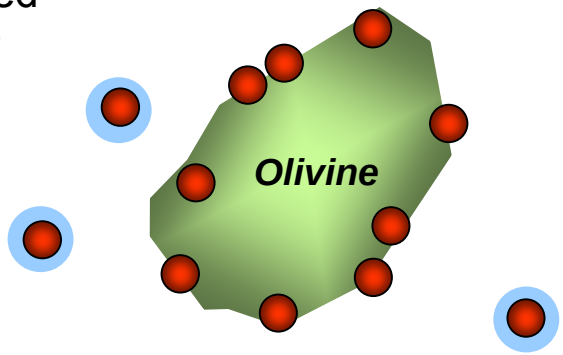
- Several applications of olivine as environmental mineral is based on two important properties:
- The ability to neutralize acid
- The ability to adsorb heavy metals permanently by chemical bindings on the crystal lattice surface.
- It is primarily the combination of several valuable characteristics such olivine a very interesting alternative.



Chemisorption and Physical adsorbtion

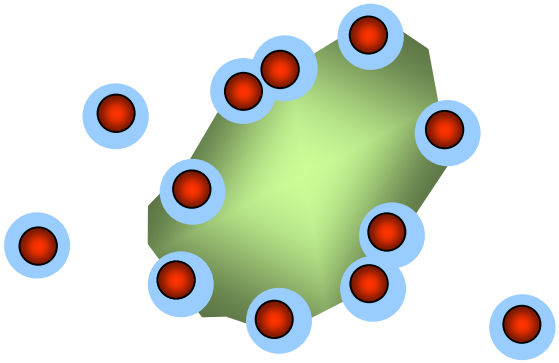
In water solutions - heavy metal ions are normally ”shielded” by water molecules. This ”shield” is stripped off when the ions are adsorbed to the olivine surface



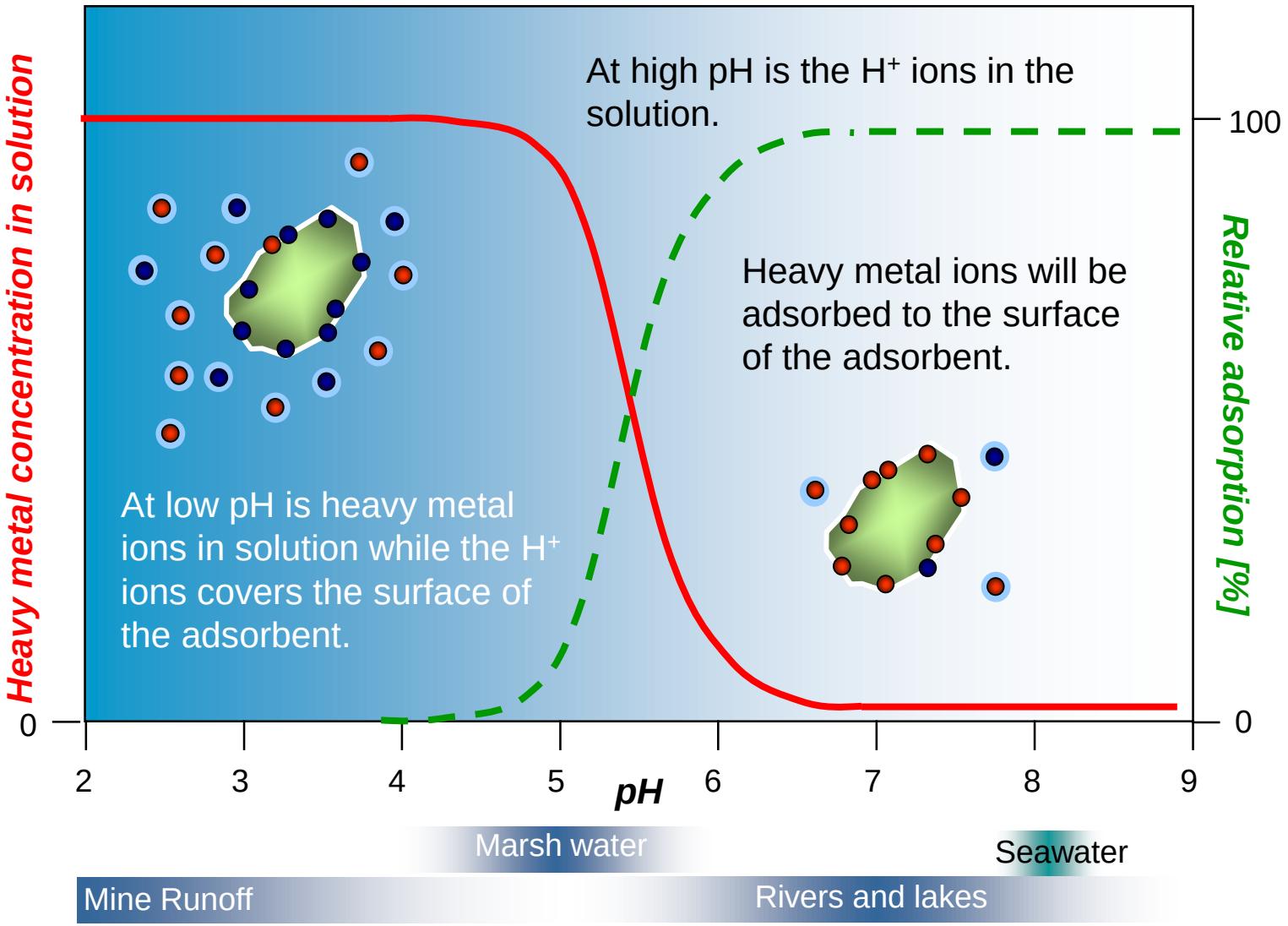


By **chemisorption** there is a direct bond between the heavy metal ion and the mineral surface

By physical ***adsorbtion*** the ions are adsorped ***electrostaticly*** without loosing the ”water molecule shell”



pH affects the adsorption



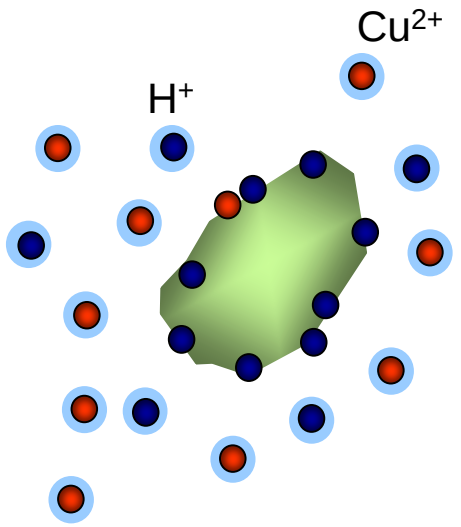
pH affects the adsorption

- The concentration of H^+ ions in solution (given by pH) is the most important variable which controls the adsorption of heavy metals on the surface of an adsorbent.

- ***We can imagine this as a competition for adsorption sites where H^+ ions will outperform heavy metals.***

- ***Low pH = much H^+ = low heavy metal adsorption***
- ***High pH = low H^+ = high heavy metal adsorption***

$$pH = -\log[H^+]$$

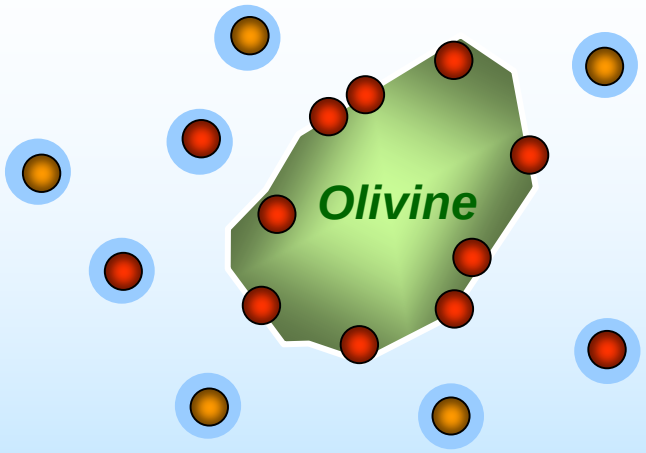


Chemisorption and Physical adsorbtion

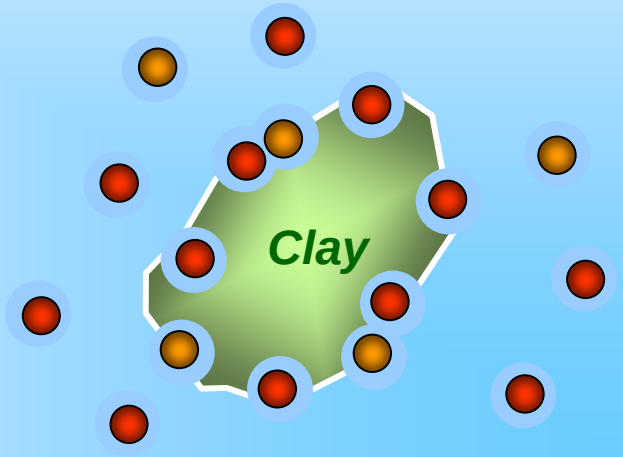
- ***Chemisorption*** depends on the ions to be adsorbed ***fits into the structure of the mineral***. When this is the case, we get a strong chemical bond. Other ions that do not fit will not be able to steal seats on the mineral surface.

- ***Physical adsorption*** is much less selective (specific). ***Here is the open competition for adsorption sites*** between many different ions. Ions present in the highest concentration will also occupy most places on the mineral surface.

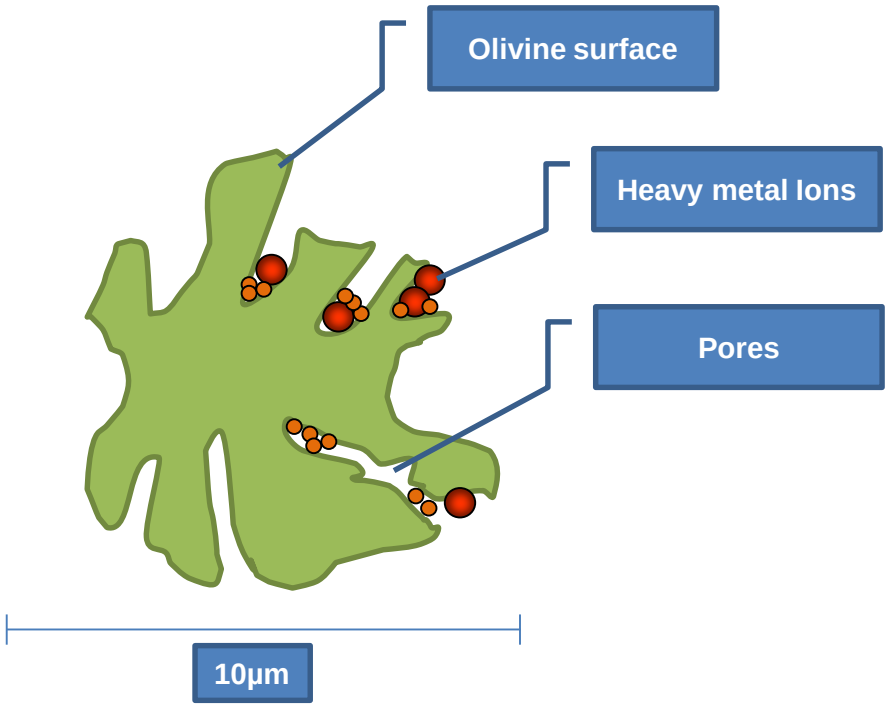
Chemisorption



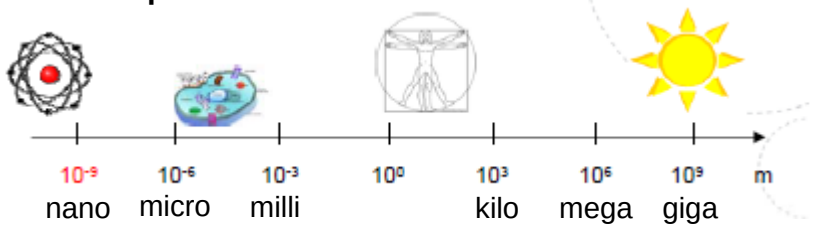
Physical Adsorption



Specific surface of olivine products

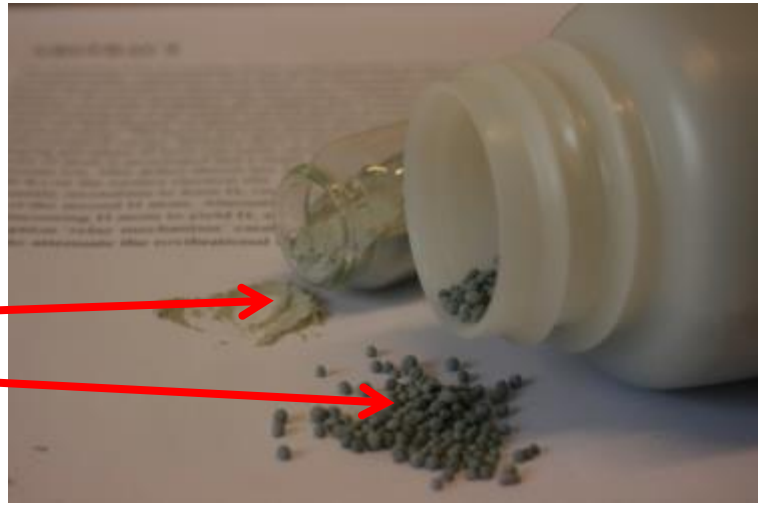


Specific surface definition



Crushed activated olivine product as Blueguard have high specific surface. This particles allows adsorption of heavy metals to the accessible surface.

Blueguard 63 (Fine Olivine)	8,6 (m^2/g)
Blueguard G1-3 (Granulate)	8,2 (m^2/g)



Neutralizing Capacity

Olivine is a basic mineral and is able to bind more acid pr. volume unit than lime, dolomite & magnesite

Mineral	*Chemical formula*	*Density*	*Acid Neutralizing capacity*	
		g/cm³	*mmolH⁺/g*	*mmolH⁺/cm³*
Lime	$CaCO_3$	2.72	19.98	54.35
Dolomite	$CaMg(CO_3)_2$	2.86	21.69	62.04
Magnesite	$MgCO_3$	2.98	23.72	70.68
Forsterite	Mg_2SiO_4	3.22	28.43	90.97
Plagioclas	$CaAl_3Si_2O_8$	2.76	28.77	78.66
Enstatite	$MgSiO_3$	3.22	19.92	63.75

Chemical reaction

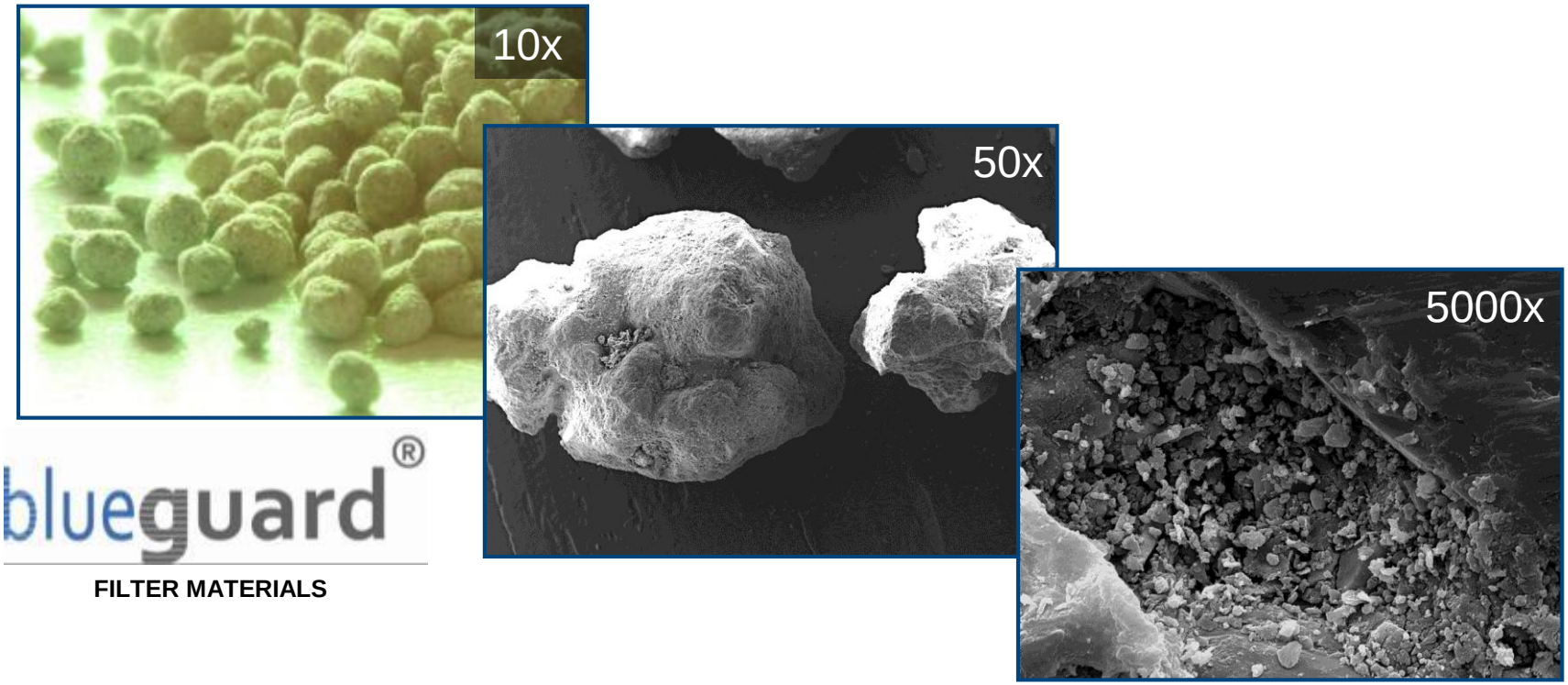
$$Mg_2SiO_{4(s)} + 4H^+ \rightarrow 2Mg^{2+} + H_4SiO_4^0$$

Olivin (Fo_{93}) vs. Kalkspat

- 1.68 (1.56) pr. volume unit
- 1.38 (1.28) pr. weight unit

Adsorption Capacity of Blueguard granulated filter products

Olivine Granules BLUEGUARD G1-3 adsorbs / traps 3.48 kg Cu^{++} / tons



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Microscopy Images of Granulated Olivine products

Adsorbtion of heavy metal vs pH

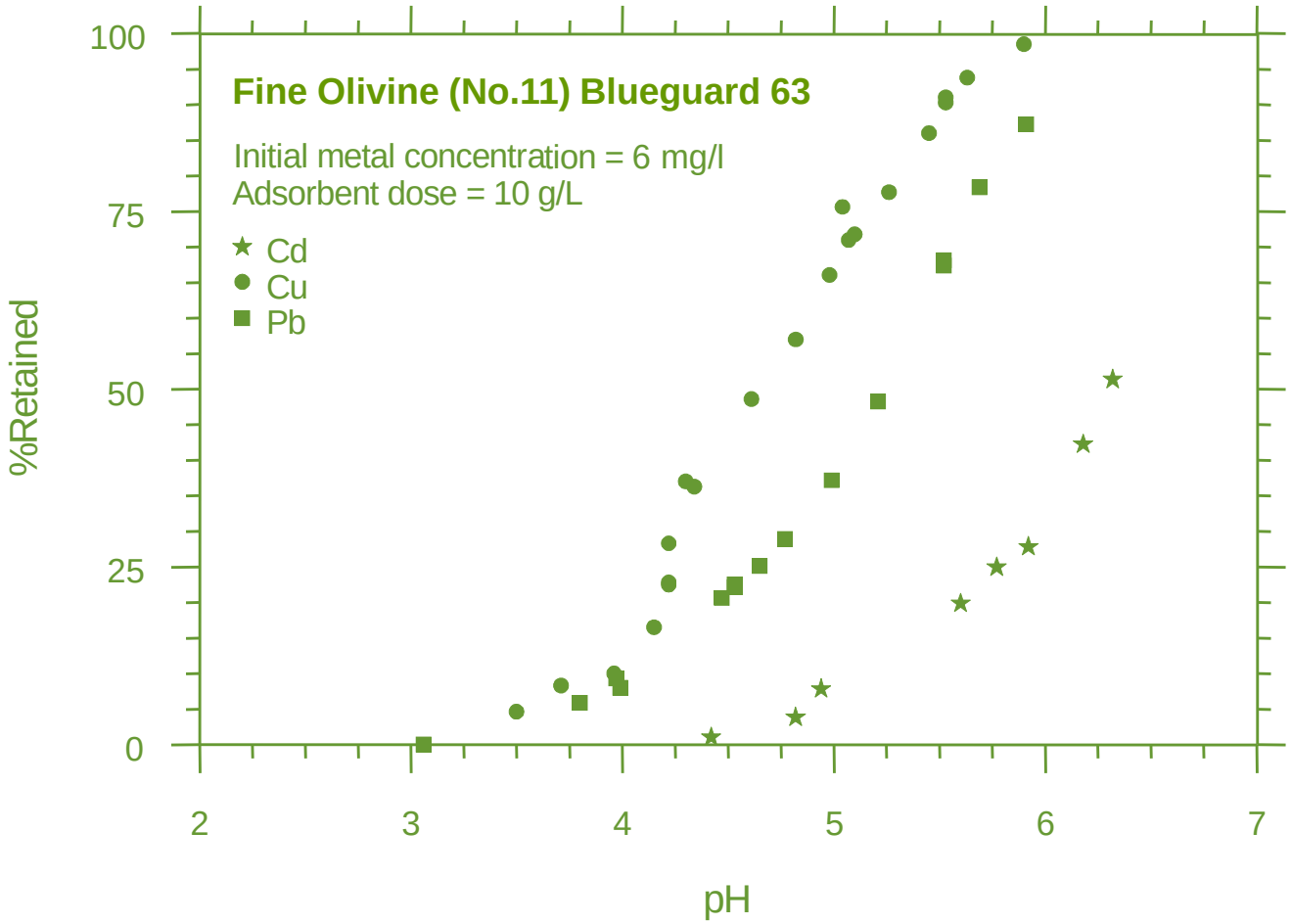

Fig. 1. Binding of cadmium, copper and lead on olivine no 11 (Blueguard 63) as a function of pH.

Benefits using olivine

Benefits using olivine

- High acid neutralizing capacity
- Binding also by low pH-values
- Permanent chemical binding of the heavy metals
- High binding capacity also in seawater (salt)
- Activated surface by crushing of the mineral

Case: RENA - Heavy Metal Cleaning

Region felt Østlandet. - Heavy metal Cleaning effect of Olivine Blueguard 63. Base water originates from Merramyra

Parameter	Base water (μ grams / litre)	Contaminated water (μ grams / litre)	Cleaned water (μ grams / litre) [percentage removed]
pH	5,6	7,4	8,1
Arsenic (As)	0,41	1,8	0,21 [88 %]
Lead (Pb)	1,1	4,5	0,41 [91 %]
Cadmium (Cd)	0,16	0,46	0,096 [79 %]
Chromium (Cr)	0,52	1,3	0,60 [54 %]
Copper (Cu)	0,74	5,4	1,1 [80 %]
Nickel (Ni)	0,58	7,0	1,7 [76 %]
Zink (Zn)	10,0	10,0	<0,50 [95 %]

Contaminations as found in **Contaminated water** column, is obtained by shaking base water with heavy metal containing crushed rocks of Deifjell. **Cleaned water** column illustrates the cleansing effect achieved when contaminated water is shaken with olivine flour.

Norwegian Department of defence, Building sector, “Heavy metals in East region Norway”, Dr. Scient. Tore Østeraas, COWI

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ACTIVE MATERIALS FOR SOIL MANAGEMENT

Applications – Case examples

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REACTIVE CAPPING MATERIALS

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FILTER MATERIALS

Case : Tverrfjellet Mine, Hjerkinn - Norway

Runoff from copper mine. Filter media: Blueguard granulate. Car tyre cuts at the bottom. Filter size: Approx. 8 m3. About 80 m3 water/24hours. i.e. 3,3 m3/h. Retention time (calculated): 1h. Retention time were tested down to 15 minutes. Absorption no problem with respect to time, but with to high flow rate there is a great risk of channel building, and the filter will then work bad. pH influent: Approx 6-6,5. pH effluent: 7,5-8. There is a lot of iron in the untreated water. This is not given in the analysis below.

From the top of the air shaft. The filter station will be built in this area.

Element	Untreated µg/l	Treated µg/l	Removed %
Pb	7,0	0,24	97
Cd	70	2,6	96
Cu	4000	47	99
Ni	26	4,1	84
Zn	25000	490	98
As	1,0	<0,2	>95

Three types of systems are tested on Hjerkinn, upstream filters, gravity filters and contact filter. The operation of the facilities have been problematic due to massive deposition of hydroxides and gypsum in the feed pipes, valves and water meters. It is therefore linked some uncertainty to the total amount of water that has passed and the plants used in estimates of treatment effects. Counter filter, built into a 9 m3 large tank, worked very satisfactorily without clogging, even after 4 months. Operation and a total load of over 10 000 m3 of water. At the end of the experiments were cleaning effect of Cd about 96%, for Cu 99%, for about 97% Pb and Zn 98%. The concentration of bound heavy metals in the filter media, were measured respectively. 2.5 kg / ton, 2.1 kg / ton and 1.1 kg / ton for copper, zinc and nickel.

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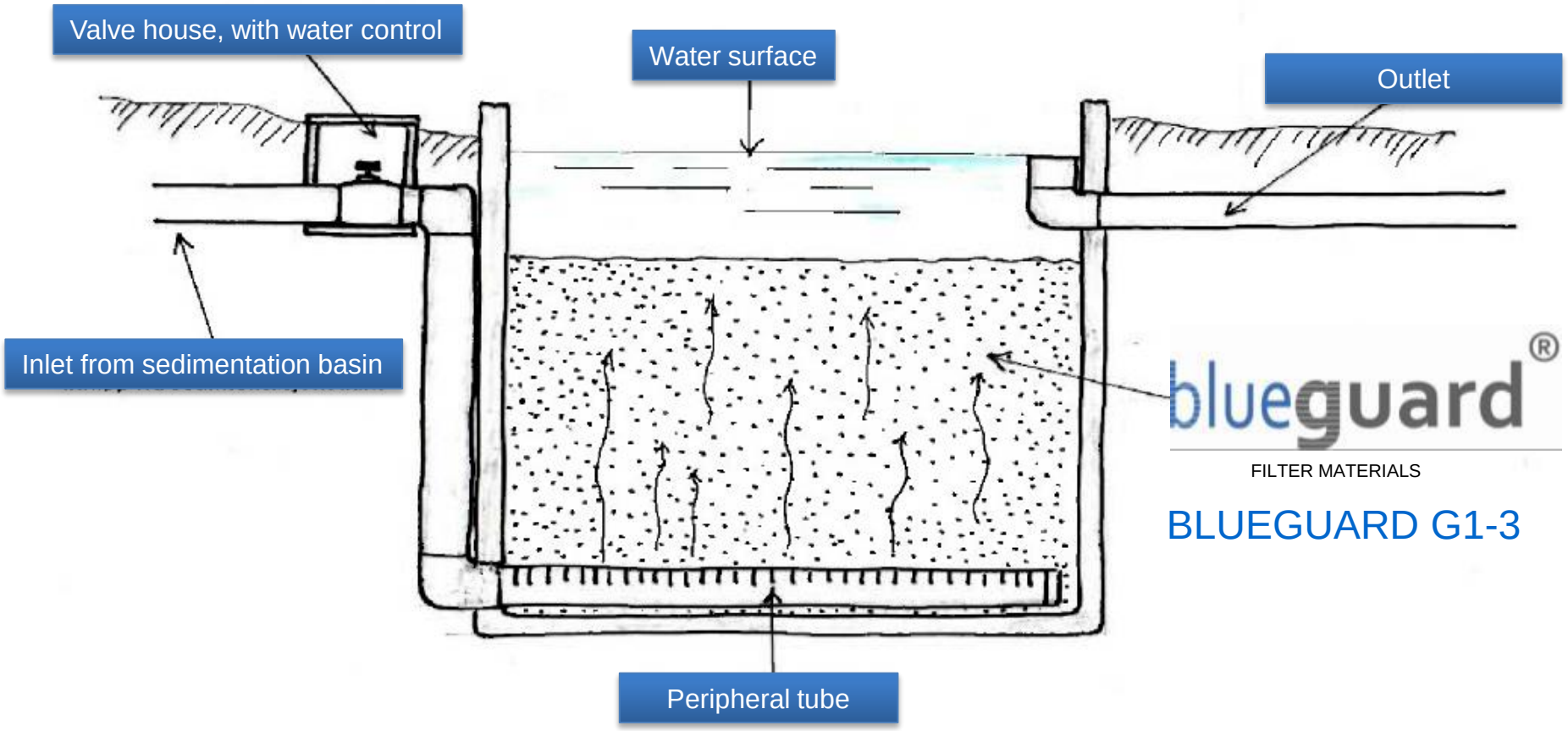
FILTER MATERIALS

BLUEGUARD G1-3

Case : Tverrfjellet Mine, Hjerkinn - Norway



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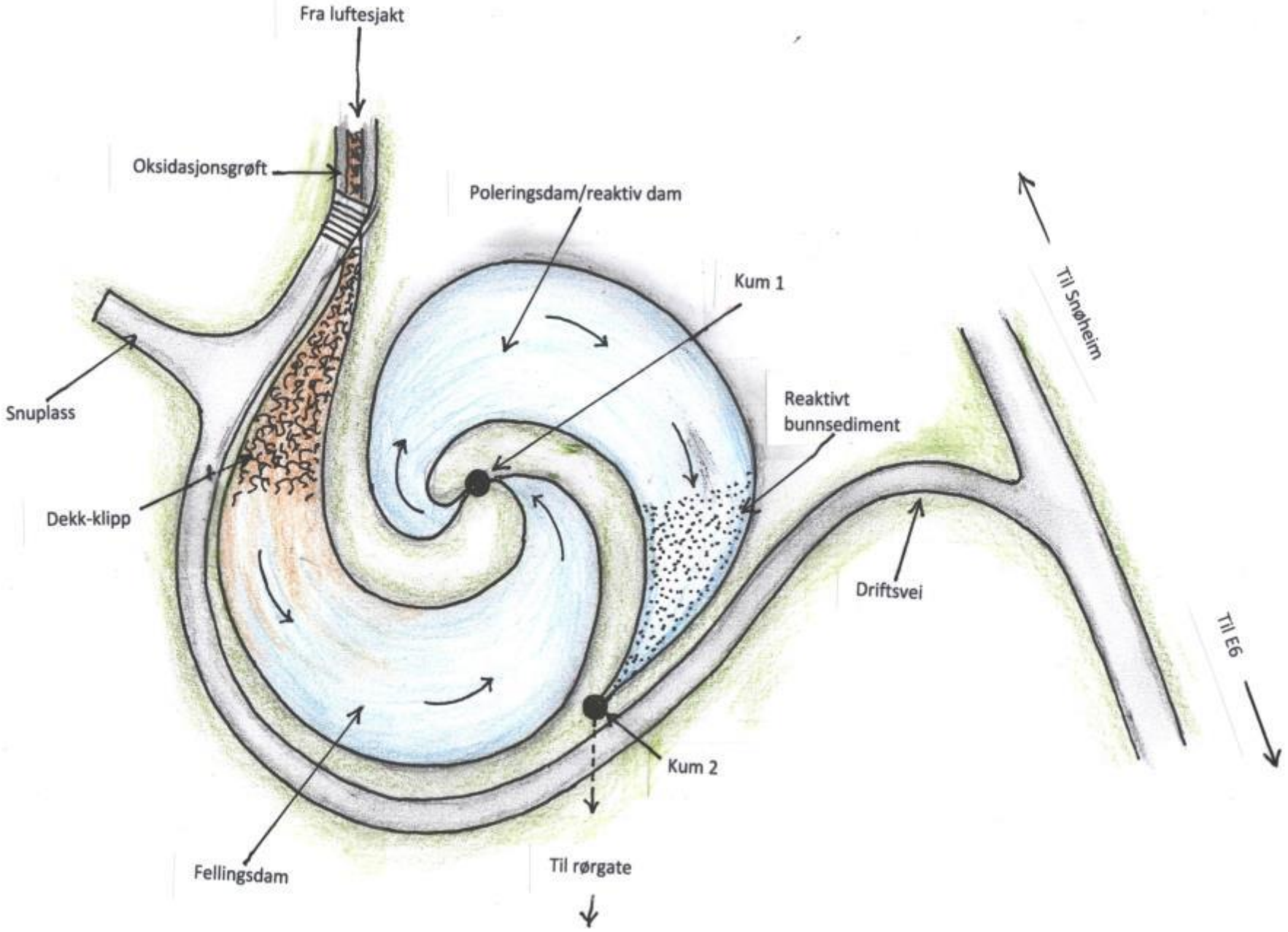
FILTER MATERIALS

BLUEGUARD G1-3

Planed construction: 50m³ filter materials. Previously performed experiments at Tverrfjellet mines shows that the BLUEGUARD FILTER MATERIALS is a suitable filter medium. The installation is at 1.6 t / m³ x 50 m³ = 80 tons BLUEGUARD G1-3


Fra luftesjakt
Oksidasjonsgrøft
Poleringsdam/reaktiv dam
Kum 1
Til Snøheim
Snuplass
Reaktivt
bunnsediment
Dekk-klipp
Driftsvei
Til E6
Kum 2
Fellingsdam
Til rørgate

Hjerkinn Mine – October 2013

Case: Oppland Metall, Norway -

Runoff from scrap metal and scrap electronics recycling plant.

Filter media: Blueguard G1-3. Filter size: Approx. 10 m^3. Water inlet in bottom. Water outlet at top. Flow rate can vary very much dependent of rain amount. Retention time min. 30 minutes . Measurement every 1000 m^3 passing the filter. pH influent: Above 5. Normally 6-7. pH effluent: 7,5-8.

Further project action: New filter is installed in January 2012, it is still running good. Expecting rebuilding and changing of filter in spring / summer 2014.

Elements	Untreated µg/l	Treated µg/l	Cleaning effect %
As	0,43	0,40	7
Pb	0,98	0,013	95
Cd	0,14	0,018	87
Cu	13	0,089	99
Ni	8,9	5,1	43
Zn	190	0,63	99

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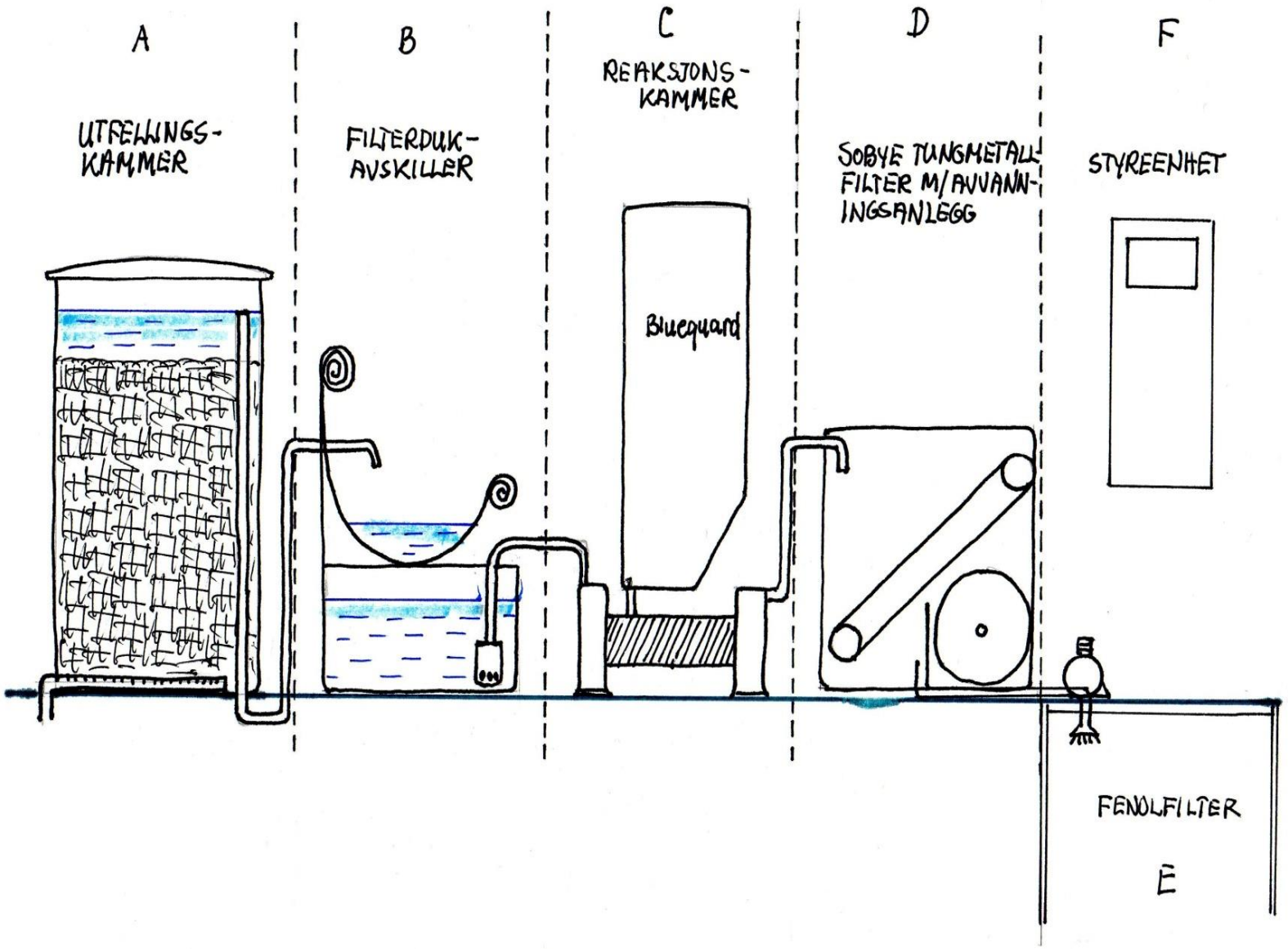
FILTER MATERIALS

BLUEGUARD G1-3

Case: Metallco (Oppland Metall) Norway



Case: Rena is Norway's newest military base

and plays host to several of the Army's departments.

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FILTER MATERIALS - BLUEGUARD G1-3

Parameter	Concentration "in water"	Concentration after passing the barrier	Treatment efficiency
Cu	2 200	43,8	98 %
Zn	100	1,6	98 %
Ni	7,9	0,42	95 %

Rena Military Camp - November 2013
Installing of 100 mt Blueguard G1-3 at a new type of shooting range and a new type of ammunition called "frangible ammunition" (means fragments/ through deformation and consists of 99% Cu)

Treatment efficiency with lysimeters test.

Reactive barrier for runoff from frangible powder. The concentrations are in µg/l

Concentration after passing the barrier is adjusted for the effect of purifying the cover material from the court 2 in Camp Rena.

Case 4: Lysimeter - OLIVINE FOR ENVIRONMENTAL APPLICATIONS

Hjerkinn Shooting Range. Leakage from heavy metal contaminated soil.

The test is done with a 100 liter drum. Approx. 20 cm draining mix (non reactive) at bottom of the drum. Above this the contaminated soil. Thickness approx 25-30 cm. 0,5 cm Blueguard 63 on top. Water shower over the drum to simulate rain. Amount max. 100 mm/24h. pH influent: approx. 7. pH effluent not measured.

Element	Untreated µg/l	Treated µg/l	Cleaning effect %
Pb	6,1	2,2	64
Cd	0,16	0,084	48
Cu	51	15	71
Cr	25	3,0	88
Ni	17	17	0
Zn	35	32	9
As	3,1	0,45	85

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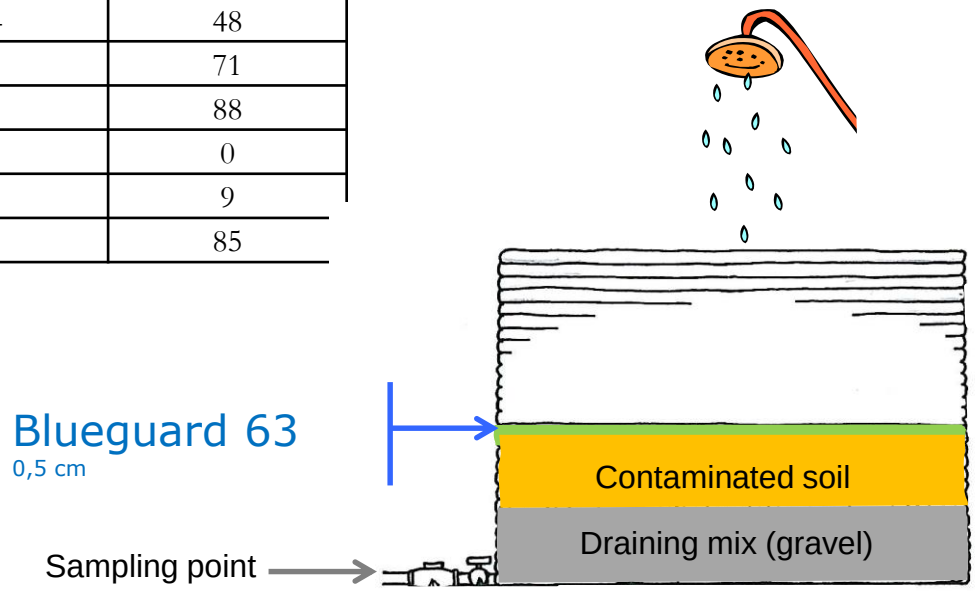
BLUEGUARD 63



War against heavy metals - bombed with olivine

War against heavy metals! (From an article in the Magazine “Vi Menn”)

The defence range at Hjerkinn is bombed again but this time with the mineral olivine!

The largest nature restoration project in Norway for both defence and nature conservation sector has attracted international attention. The entire area at Hjerkinn will be cleared from ammunition residues and other waste.

In fact 3000 tons of olivine have been flown out to the area and released from a helicopter to ensure even distribution of the material.

STABILIZING CONTAMINATION

Covering/Capping of polluted sea beds

Sibelco Nordic has developed a product that shows extraordinary adsorption abilities towards both heavy metals and organic toxic compounds. The product is based on the natural mineral OLIVINE

Ålesund Harbour

Kirkebukten Bergen Harbour

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REACTIVE CAPPING MATERIALS

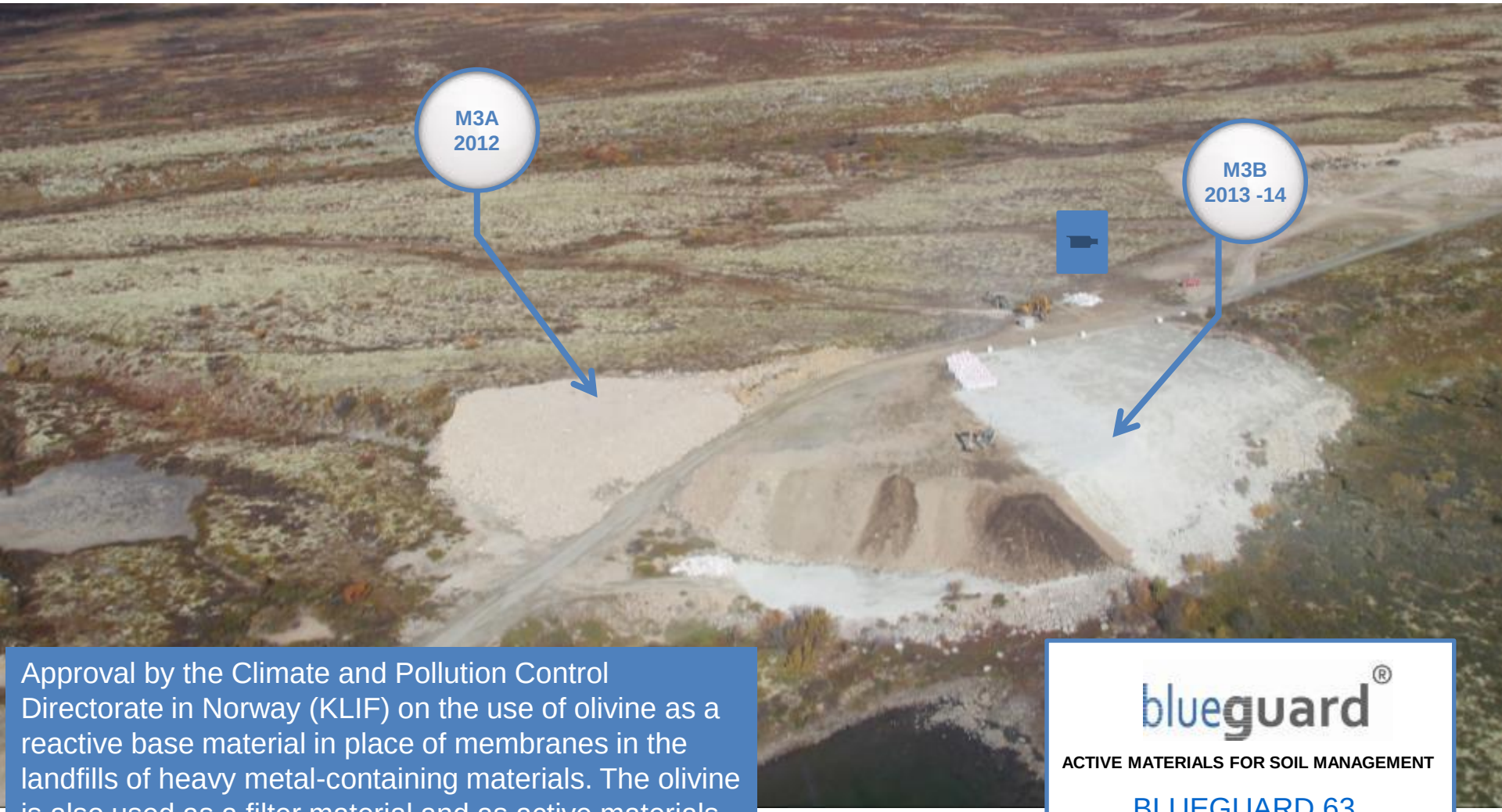
The Climate and Pollution Agency (Klif) is Norwegian Ministry of the Environment. Recent years Kliff have had strongly focused on pollution of harbors and coastal waters along the Norwegian coast

Sediments on the sea floor are formed by particulate matter that settles out of the water column, and may consist of anything from coarse gravel and sand to clay and organic ooze. In many areas discharges of hazardous chemicals over many years have resulted in high levels of pollution in sediments. Contaminants “stored” in such sediments may cause serious pollution problems.

Hjerkinn 165 km^2 Area - Europe's largest military revegetation project

Dropping Blueguard 63 – HFK plain Hjerkinn 2013

Landfill at **Storanden, Hjerkinn**
Status October 2013



Approval by the Climate and Pollution Control Directorate in Norway (KLIF) on the use of olivine as a reactive base material in place of membranes in the landfills of heavy metal-containing materials. The olivine is also used as a filter material and as active materials for soil management

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ACTIVE MATERIALS FOR SOIL MANAGEMENT

BLUEGUARD 63

BENTONITE

Landfill – «The Hjerkinn methode»

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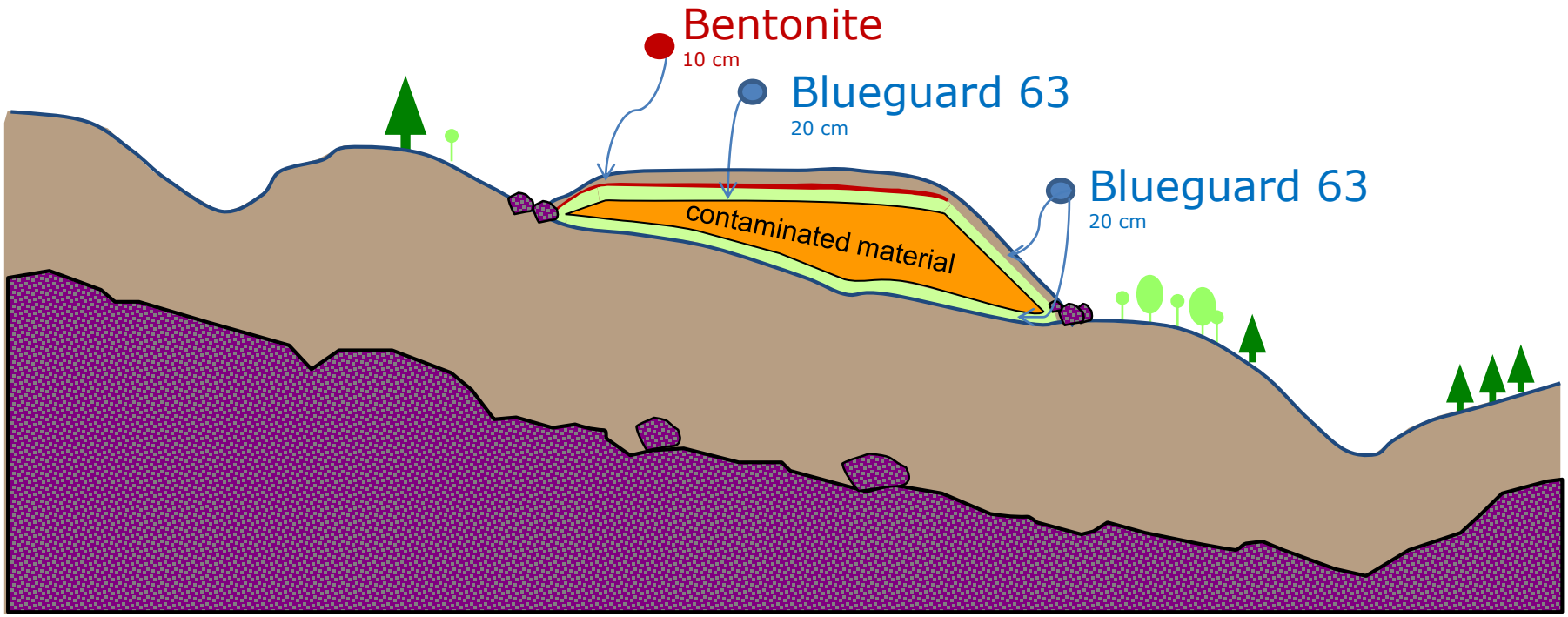
ACTIVE MATERIALS FOR SOIL MANAGEMENT

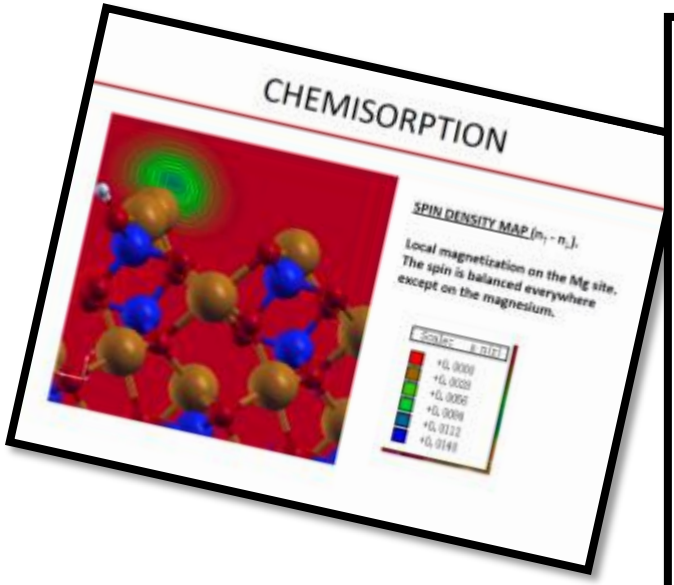
BLUEGUARD 63

Approval by the Climate and Pollution Control Directorate in Norway (KLIF) on the use of olivine as a reactive base material in place of membranes in the landfills of heavy metal-containing materials. The approval applies for the moment only to Forsvarsbygg, and it must be sought in each project case.



Olivine - publications

The last years publications specially on internet is huge. If we use this words: «olivine adsorption heavy metals» we got approx 1,6 million «hits»



Løkken Area

Map of Løkken with landfill sites

Figur 2 Oversiktskart over Løkken gruveområde med deponiområder.

Løkken Verk – Pilot Project 2014

Blueguard G1-3
=100 tonnes

Blueguard 200
20 000 m^2 x 0,02 m x 1,6 t/m^3
=1200 tonnes

Bentonite AC 200
20 000 m^2 x 0,02 m x 0,81t/m^3
=400 tonnes

Blueguard 120
8 000 m^2 x 0,02 m x 1,6 t/m^3
- 1400 ton

Bentonite mats

Danske Vejdirektoratet

The order is 200 tons Blueguard G1-3 premixed 1/3 with suitable quarts sand from Dansand. The production has started at Åheim. Delivery Denmark summer 2014.

Sibelco will work together with Dansand in this project both in supplying and manufacturing different kind of products into this special filter.

An innovation project, because delivery to a total new application area, and because of the mixing with quartz sand.

Danske Vejdirektoratet

Korskær creek is characterized as the finest and cleanest rivers in the entire motorway and the area has a very diverse flora and fauna, which of course we must taken care of. The water that runs from the highway by rain, is in definition polluted, and general rainwater tanks can not remove all substances dissolved in the water. The Road Directorate want to use a new nature-based technology to clean purified water before it ends up in the creek.

Road Directorate in collaboration with Aalborg University have establish a newly developed filter systems, which are placed in continuation of rainwater basin. The filter system consists of all-natural materials such as crushed shells, peat and Norwegian rocks, and it is established by Korskær Creek within the road's opening in 2015.

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FILTER MATERIALS

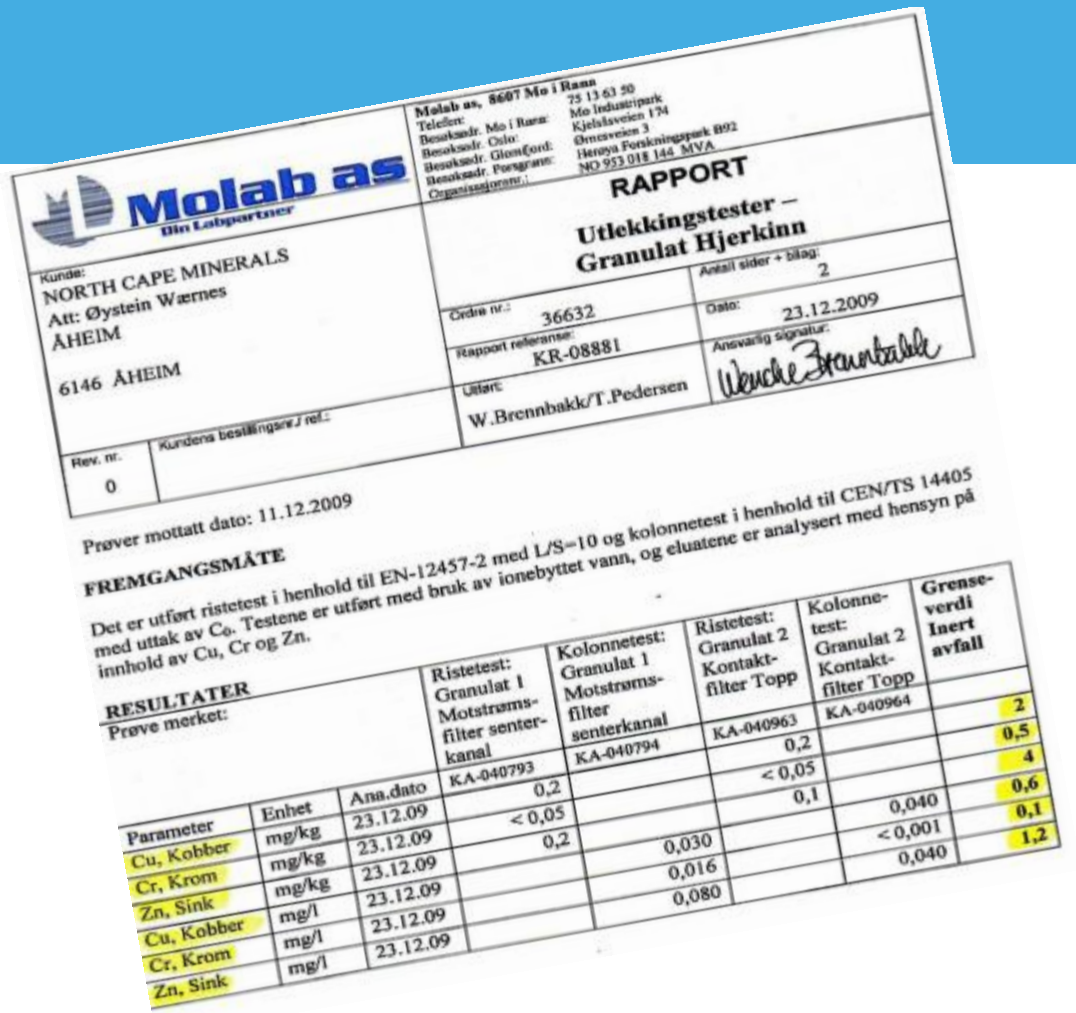
BLUEGUARD G1-3

Selling pitches

Stability against leakage

An important characteristic of a filter medium is how strongly the heavy metals bound in the media and how easy they are addressed by external influences. This indicates stability against leakage. The stability is affected by numerous factors and include a function of bonding the mold and the supply of competing metals. Usually considered chemisorption, also called mineralization, as the most stable bonding form.

To get an objective picture of the olivine stability against leakage of heavy metals were saturated olivine granules of the type used from the Hjerkinn and RØ tested at Molab. It was conducted leaching test for copper, zinc and chromium according to EN-12457-E with L / S = 10 and column tests according to CEN / TS 14405.



Molab as
Din Labpartner

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Telefon: 75 13 63 50
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Besøksadr. Glomfjord: Ørnesveien 3
Besøksadr. Porsgrunn: Herøya Forskningspark 892
Organisasjonsnr.: NO 953 018 144 MVA

Kunde:
NORTH CAPE MINERALS
Att: Øystein Wærnes
ÅHEIM

6146 ÅHEIM

Kundens bestillingsref./ ref.:

Rev. nr.: 0

RAPPORT
Utlekkingstester – Granulat Hjerkinn

Ordre nr.: 36632
Antall sider + bilag: 2
Rapport referanse: KR-08881
Dato: 23.12.2009
Utført: W.Brennbakk/T.Pedersen
Ansvarlig signatur:

Prøver mottatt dato: 11.12.2009

FREMGANGSMÅTE

Det er utført ristetest i henhold til EN-12457-2 med L/S=10 og kolonnetest i henhold til CEN/TS 14405 med uttak av C_0. Testene er utført med bruk av ionebyttet vann, og eluatene er analysert med hensyn på innhold av Cu, Cr og Zn.

RESULTATER

Prøve merket:			Ristetest: Granulat 1 Motstrøms-filter senter-kanal	Kolonnetest: Granulat 1 Motstrøms-filter senterkanal	Ristetest: Granulat 2 Kontakt-filter Topp	Kolonne-test: Granulat 2 Kontakt-filter Topp	Grense-verdi Inert avfall
Parameter	Enhet	Ana.dato	KA-040793	KA-040794	KA-040963	KA-040964	
Cu, Kobber	mg/kg	23.12.09	0,2		0,2		2
Cr, Krom	mg/kg	23.12.09	< 0,05		< 0,05		0,5
Zn, Sink	mg/kg	23.12.09	0,2		0,1		4
Cu, Kobber	mg/l	23.12.09		0,030		0,040	0,6
Cr, Krom	mg/l	23.12.09		0,016		< 0,001	0,1
Zn, Sink	mg/l	23.12.09		0,080		0,040	1,2

Figure 13 Results of stability test of olivine granules saturated with heavy metals. Samples are taken from the contact filter by Tverrfjellet mines at Hjerkinn.

Selling pitches

Selling pitches

Parameter	Referanse 19.08.2013	Grunnvanns-utslag 1 19.08.2013	Grunnvanns-brønn 19.08.2013	Grunnvanns-tjern 19.08.2013	NIVA Grunnvanns-tjern 10.08.2011	NIVA Grunnvanns-brønn 10.07.2007
Bly	0,41	14	0,027	0,11	0,18	2,85
Kadmium	<0,004	0,044	0,13	0,005	1,08	2,3
Kobber	5,5	8,3	9,5	1,0	94,3	2 800
Krom	0,56	0,30	0,074	0,11	0,1	2,3
Nikkel	0,26	0,60	0,49	0,57	2,28	292
Sink	0,38	13	17	2,5	164	12 000
Arsen	0,80	1,3	0,053	0,047	-	-
pH	6,2	6,3	6,2	6,8	6,5	4,33

Landfill solution is selected on the Storranden, Hjerkinn seems to be a very safe method of local deposition of heavy metals material. The reactive capping and the reactive bottom layer provides an excellent hedge against polluting runoff for the foreseeable future. The solution with a new landfill that displays the underlying old contaminants to leak allows for smart solutions elsewhere both civilian and military.

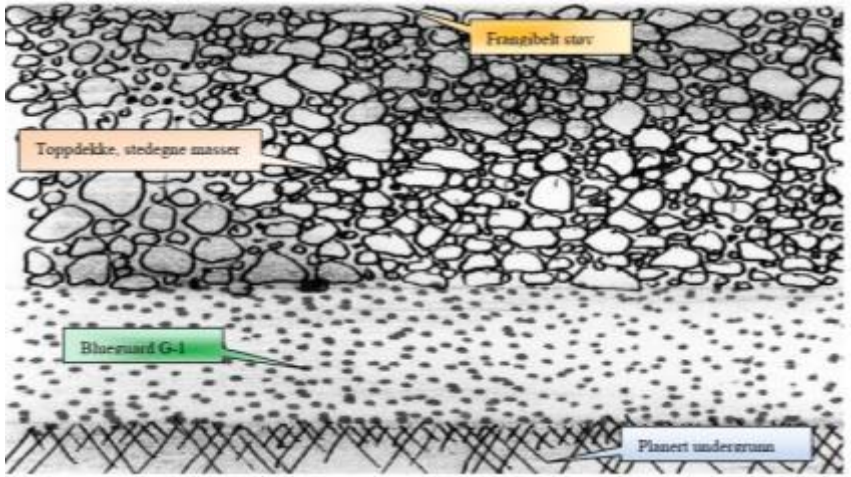
Selling pitches

Stability against leakage

An important characteristic of a filter medium is how strongly the heavy metals bound in the media and how easy they are addressed by external influences. This indicates stability against leakage. The stability is affected by numerous factors and include a function of bonding the mold and the supply of competing metals. Usually considered chemisorption, also called mineralization, as the most stable bonding form.

To get an objective picture of the olivine stability against leakage of heavy metals were saturated olivine granules of the type used from the Hjerkinn and RØ tested at Molab. It was conducted leaching test for copper, zinc and chromium according to EN-12457-E with L / S = 10 and column tests according to CEN / TS 14405.

Selling pitches



Parameter	Concentration "in water"	Concentration after passing the barrier	Treatment efficiency
Cu	2 200	43,8	98 %
Zn	100	1,6	98 %
Ni	7,9	0,42	95 %

Table 17 Treatment efficiency with lysimeters test. Reactive barrier for runoff from frangible powder. The concentrations are in µg/l Concentration after passing the barrier is adjusted for the effect of purifying the cover material from the court 2 in Camp Rena.

Sibelco - Åheim

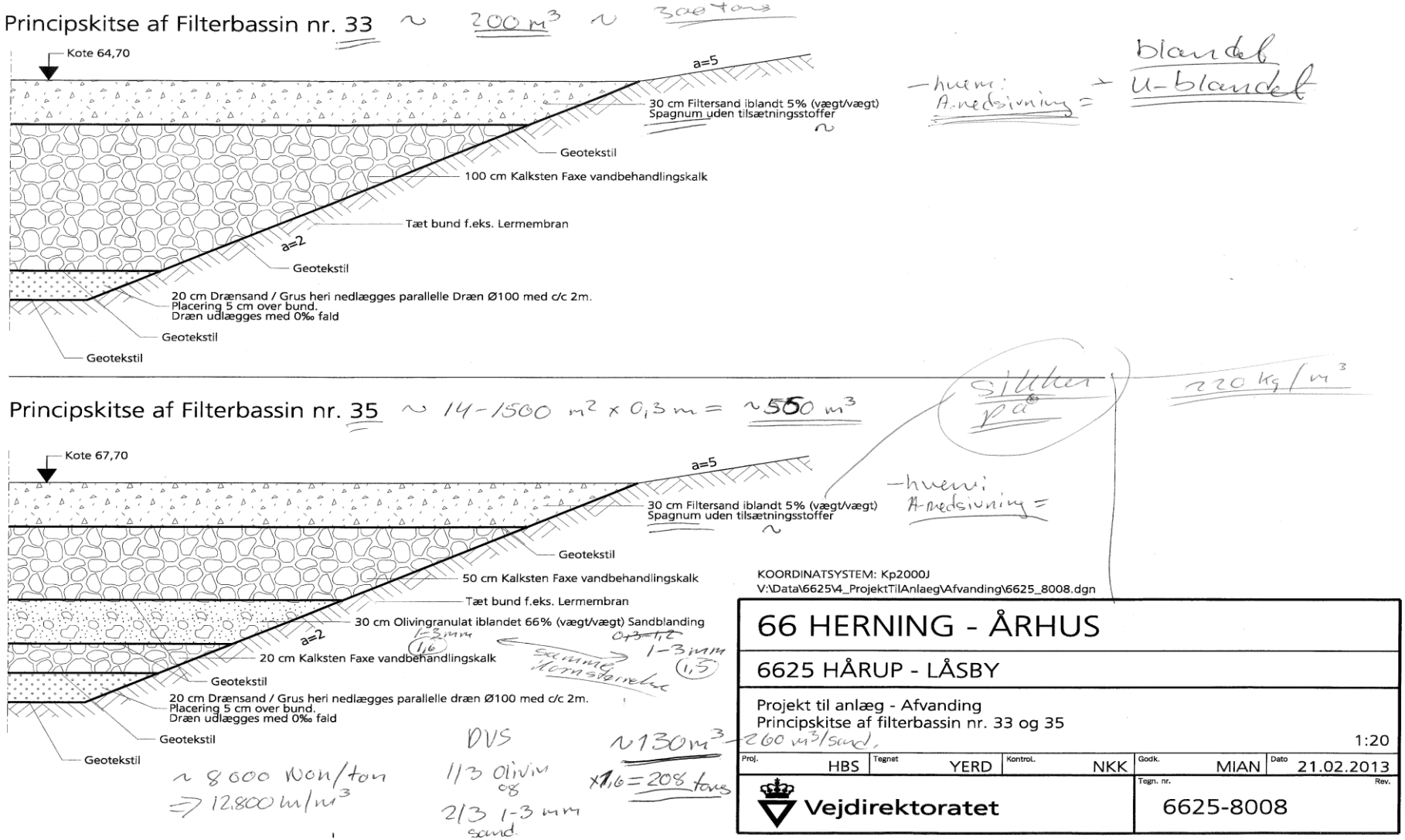
DANSAND INDUSTRI & BYGGERI

Olivinprojekt til Vejdirektoratet ved motorvejen ved Låsby

Lokal rensning af overfladevand fra 6 Ha motorvej og parkeringsplads.
Ca. 1500 m2/1500 m3 filter
0/4 mm filtersand med 5 % spagnum og 0/4 mm filtersand med 33 % Olivin Blueguard
samt vandrensningskalk(bygherreleverance)
Skal renses for især tungmetaller inden afløb til vandløb.

Stor ros til Jermund Rekkedal for særdeles godt samarbejde.

Opbygning af filter med Olivin Blueguard 1-3 G



Trin 1. Udgravet bassin med lermembran

DANSAND INDUSTRI & BYGGERI

Vandbehandlingskalk(bygherreleverance)

Nærbillede af filtermedie 33 % Olivin Blue Guard og 66 % filtersand.

Sorptionsskema for Olivin Blueguard(bemærk at der er flere typer)

SORPTION TESTING WITH OLIVINE

REPORT No.	CONTAMINANT	SOLVENT	SORPTIVE OLIVINE QUALITY	CONTAMINANT CONCENTRATION [µg/L]	EFFECTIVE SORPTION [%]
4490	Antimony, Sb	Fresh water	Blueguard G1-3 2769	10	99
4490	Phosphate, $PO4^{2-}$	Fresh water	Blueguard G1-3 2769	10	100
4487	Copper, Cu	Fresh water	Blueguard G1-3 2768	100	99
4487	Copper, Cu	Fresh water	Blueguard G1-3 2768	10 000	99
4487	Copper, Cu	Fresh water	Blueguard G1-3 2761	100	99
4487	Copper, Cu	Fresh water	Blueguard G1-3 2761	10 000	99
4491	Aluminium, Al	Fresh water	Blueguard G1-3 2761	10 000	78
4490	Antimony, Sb	Fresh water	Blueguard G1-3 2761	10	91
4490	Phosphate, $PO4^{2-}$	Fresh water	Blueguard G1-3 2761	10	100
4489	Arsenic, As	Fresh water	Blueguard G1-3 2761	10 000	95
4489	Cadmium, Cd	Fresh water	Blueguard G1-3 2761	10 000	100
4489	Cobolt, Co	Fresh water	Blueguard G1-3 2761	10 000	100
4489	Chromium, Cr	Fresh water	Blueguard G1-3 2761	10 000	100
4489	Copper, Cu	Fresh water	Blueguard G1-3 2761	10 000	100
4489	Zink, Zn	Fresh water	Blueguard G1-3 2761	10 000	100
4489	Antimony, Sb	Fresh water	Blueguard G1-3 2761	10 000	80
4489	Lead, Pb	Fresh water	Blueguard G1-3 2761	10 000	100
4489	Nickel, Ni	Fresh water	Blueguard G1-3 2761	10 000	100
4489	Manganese, Mn	Fresh water	Blueguard G1-3 2761	10 000	100
4483	Phosphate, $PO4^{2-}$	Fresh water	Blueguard G1-3 2758	20	87
4483	Phosphate, $PO4^{2-}$	Fresh water	Blueguard G1-3 2757	20	85
4483	Phosphate, $PO4^{2-}$	Fresh water	Blueguard G1-3 2756	20	73
4485	Phosphate, $PO4^{2-}$	Fresh water	Blueguard G1-3 2756	1 000	100
4486	Copper, Cu	Fresh water	Blueguard G1-3 2756	1 000	100
4486	Copper, Cu	Fresh water	Blueguard G1-3 2756	1 000	100
4486	Copper, Cu	Fresh water	Blueguard G1-3 2756	1 000	99
4467	Tri-Butyl Tin, TBT	Fresh water	Blueguard G1-3 2749	1,1	96
4467	Tri-Phenyl Tin, TPhT	Fresh water	Blueguard G1-3 2749	0,4	91
4467	PAH 16	Fresh water	Blueguard G1-3 2749	10	87
4467	PCB 7	Fresh water	Blueguard G1-3 2749	10	88
4481	Antimony, Sb	Fresh water	Blueguard G1-3 2749	10	45
4487	Copper, Cu	Fresh water	Blueguard G1-3 2749	100	93
4487	Copper, Cu	Fresh water	Blueguard G1-3 2749	10 000	98
5173	Copper, Cu	Fresh water	Blueguard G1-3C 2917	10 000	100
5296	SUM THC (>C5 – C35)	Fresh water	Blueguard G1-3C 2917	-	100
5306	Methylmercury	Fresh water	Blueguard G1-3C 2917	0,000141	88
5306	Mercury, Hg	Fresh water	Blueguard G1-3C 2917	0,182	89
4481	Antimony, Sb	Fresh water	Blueguard 63	10	60
4482	Chromium, Cr	Fresh water	Blueguard 63	10	99
4486	Copper, Cu	Fresh water	Blueguard 63	1 000	100
4486	Copper, Cu	Fresh water	Blueguard 63	1 000	100
4486	Copper, Cu	Fresh water	Blueguard 63	1 000	100
4491	Aluminium, Al	Fresh water	Blueguard 63	10 000	100

Referencer: Molab rapport, AnalyCen rapport, COWI rapport, NIVA report. Ved ønske om detaljerede referencer og rapporter henviser vi til Peter Svensen på email; psv@dansand.dk

Benytt gjerne følgende kontaktinformasjon for nærmere opplysninger:

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Mobil: +45 2322 7258
E-mail: psv@dansand.dk

blueguard® by SIBELCO EUROPE

Vandets vej gennem anlægget:

1) Før filtreringen løber vejvandet gennem et bassin som fungerer som sandfang. Billede 1.
2) Vejvandet løber i fire vifter ud i filteranlægget og fordeles ned gennem i alt fire filtermedier. Hvert lag er adskilt med en permabel geotekstil.
3) Vejvandet filtreres først gennem 30 cm af en speciel 0/4 mm filtergrus med 5 vægt % findelt spagnum som er homogent blandet gennem Dansand`s blandeanlæg.
4) Dernæst ligger der 50 cm. vandbehandlingskalk.
5) Næste lag er et specialblandet filtermedie med 34 % 0/3 mm Olivin Blue-Guard og 66 % 0/4 mm filtersand. Igen et homogent filtermedie blandet gennem Dansand`s blandeanlæg.
6) Sidste filtermedie er igen et lag med 20 cm. vandbehandlingskalk

Anlægget er opbygget således at det det er muligt at opstemme vejvandet i bassinet, og derved kunne bestemme gennemløbs/opholdstid osv.

Der moniteres naturligvis ved både ind- og udløb, og anlægget følges nøje af bl.a. en Phd studerende gennem de første 4 år.

Anlægget er designet til en levetid > 50 år.

Sandfang før selve anlægget.

Billede 1. Sandfang

Udgravet bassin med 0,5 meter lermembran. Leret er lokalt.

Lermembran med drænrør.

Klar til næste lag

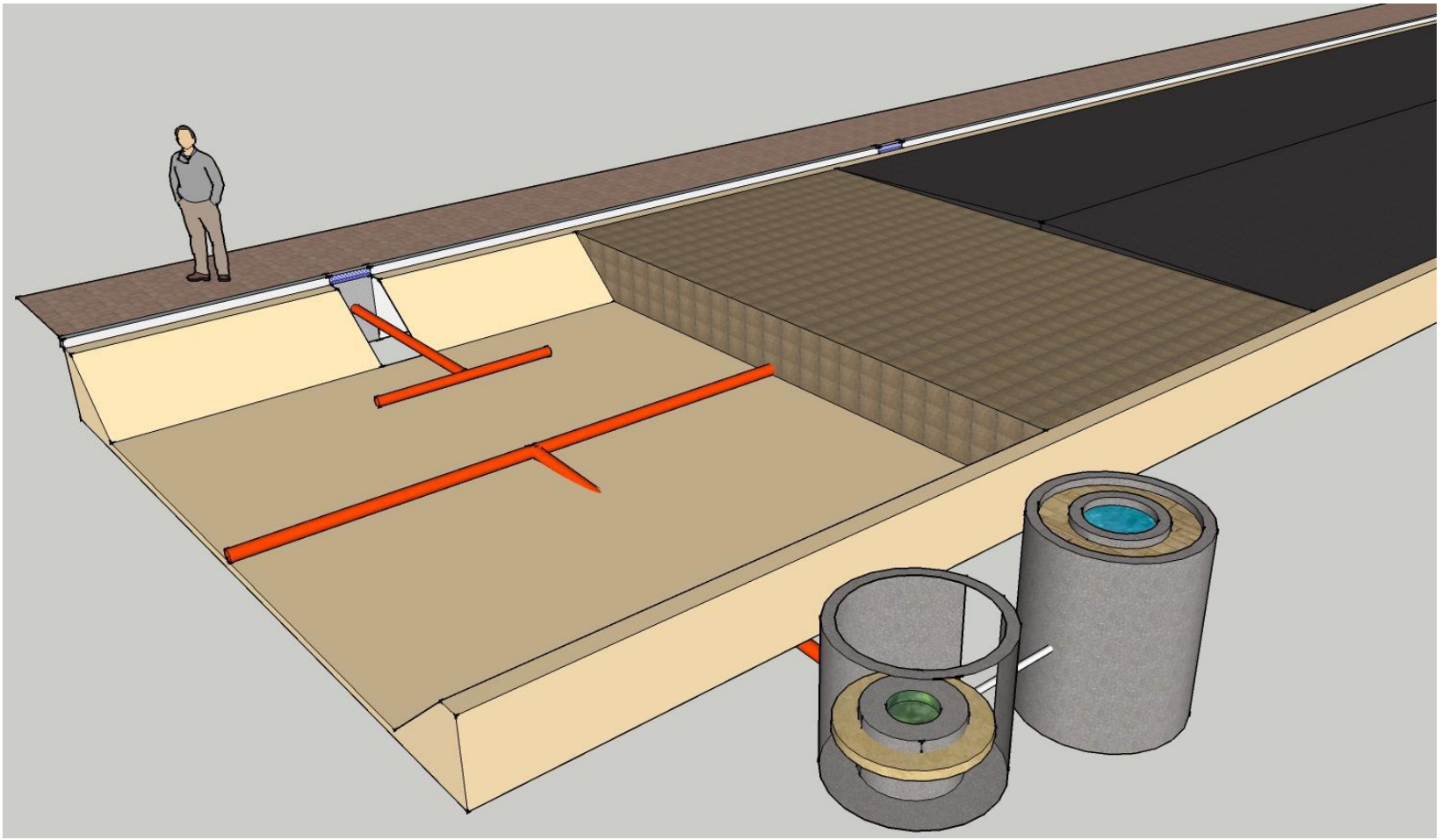
Fibertex og vandbehandlingskalk

Geotekstil og vandbehandlingskalk

Udlægning af Olivingranulat med 66% 0/4 mm sand og 33 % Olivin Blueguard

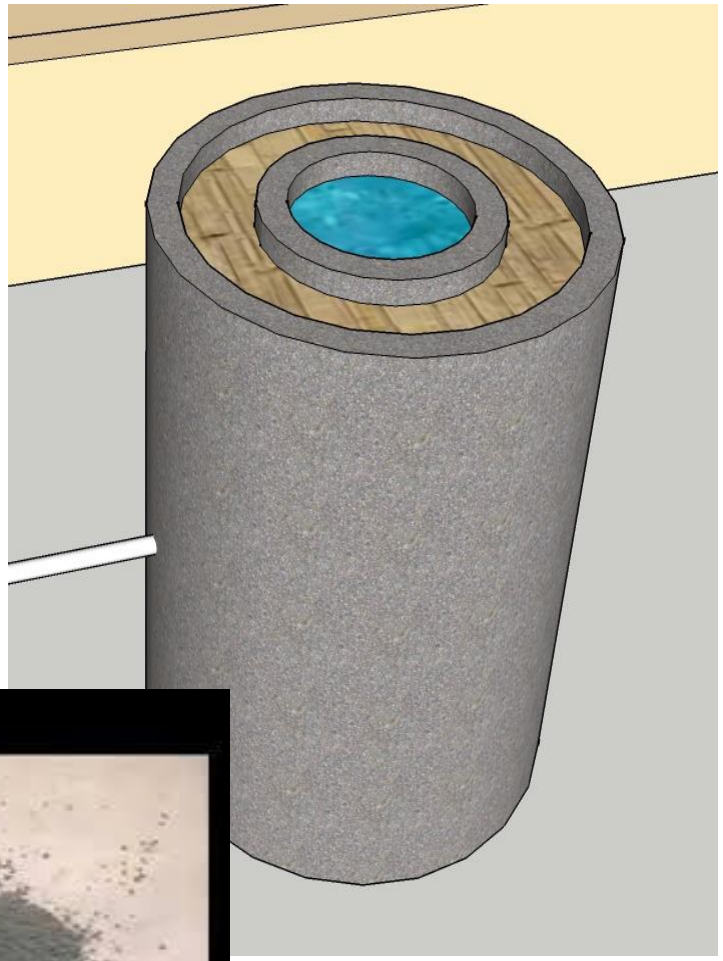
Toplag af 30 cm 0/4 mm filtergrus med 5 % spagnum

Projekt VandVejen. NCC + Tek. Inst. Udføres med NCC Drænasfalt og NCC Drænstabil med 30 % hulrum. Evt. 10 % Olivin Blueguard i nederste 20 cm eller to separate brønde. En med vandbehandlingskalk og en IBF permabel filter/brønd med Olivin.



Nedsivningsbrønd

Dobbelt permeabel betonbrønd
- Vand ledes fra filtreringsbrønd til indre brøndring. Ca. 4 l./sek. ind og ud.
- Herefter ledes det ud gennem betonen til filtersandet (BlueGuard) Ca. 4,6 tons.
- Fra filtersandet ledes vandet gennem den yderste permeable betonbrønd
- Effektiviteten af filtersandet kan designes til belastningen på lokaliteten
- Filtersandet kan udskiftes når det er udtjent



Olivin helt overordnet:

- Ved kraftige forureninger i vand eller jord.
- Dyrt.
- Der er nok af det.
- Dansand har forhandlingen i DK
- Tåler ikke olier.
- Flere forskellige typer. F.eks med aktivt kul.
- Veldokumenteret.
- Adskillige fuldscale projekter i Norge.
- Norske myndigheder og virksomheder som kunder.
- Norske professorer som anpriser

Kunder/anvendelse:

- Kommuner
- Regioner
- Andre offentlige myndigheder
- Forsyningsvirksomheder
- Genanvendelsesfirmaer(skrotpladser)
- Metalforarbejdningsvirksomheder
- Kirker med blytage.
- Bilvaskeanlæg.
- LAR-anlæg med ønske om kontrol af vand der nedsives
- Snaps(for helbredets skyld)