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

Sibelco
Olivine plant, Åheim, Norway
What is olivine?

**OLIVINE FROM ÅHEIM, NORWAY**

Mg_{1.85}Fe_{0.14}Ni_{0.01}SiO_4

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

- Foundry sand
  Refractoriness, (non existence of free silica)

- Slag conditioner in hot metal production
  (High MgO content, silicate benefits vs carbonate)

- Refractory products
  (Refractoriness, even thermal expansion)

- Sand blasting material
  (Hardness, density, grain form, no health hazard)

- IOC - Iron Oxide Coated Olivine: Product for drinking water purification

- Written contract with Norwegian Defense Estates Agency

- Environmental road water project Silkeborg, Denmark

- Blueguard Granulate for frangible ammunition, Rena

- Blueguard Pilot Capping project at Bergen Harbour

- Blueguard Granulate development - First deliveries at Norwegian Defense Estates Agency, Hjerkinn

- Bricks for night storage heaters
  (Specific heat)

- Mineral wool production
  (Stable chemical composition, no health hazard)

- Tap hole mix, and EBT sand
  (Refractoriness, density, grain form, no health hazard)

- Refractory masses, Isogun
  (Refractoriness, even thermal expansion)
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.
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 **adsorption** the ions are adsorped **electrostatically** without loosing the "water molecule shell".
At low pH is heavy metal ions in solution while the $\text{H}^+$ ions covers the surface of the adsorbent.

At high pH is the $\text{H}^+$ ions in the solution.

Heavy metal ions will be adsorbed to the surface of the adsorbent.

$pH$ 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

\[ \text{pH} = -\log[H^+] \]
Chemisorption and Physical adsorption

- **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.
Specific surface of olivine products

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 (m²/g)
Blueguard G1-3 (Granulate) 8,2 (m²/g)
## Neutralizing Capacity

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

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Chemical formula</th>
<th>Density $g/cm^3$</th>
<th>Acid Neutralizing capacity $mmolH^+/g$</th>
<th>Acid Neutralizing capacity $mmolH^+/cm^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lime</td>
<td>CaCO$_3$</td>
<td>2.72</td>
<td>19.98</td>
<td>54.35</td>
</tr>
<tr>
<td>Dolomite</td>
<td>CaMg(CO$_3$)$_2$</td>
<td>2.86</td>
<td>21.69</td>
<td>62.04</td>
</tr>
<tr>
<td>Magnesite</td>
<td>MgCO$_3$</td>
<td>2.98</td>
<td>23.72</td>
<td>70.68</td>
</tr>
<tr>
<td>Forsterite</td>
<td>Mg$_2$SiO$_4$</td>
<td>3.22</td>
<td>28.43</td>
<td>90.97</td>
</tr>
<tr>
<td>Plagioclase</td>
<td>CaAl$_3$Si$_2$O$_8$</td>
<td>2.76</td>
<td>28.77</td>
<td>78.66</td>
</tr>
<tr>
<td>Enstatite</td>
<td>MgSiO$_3$</td>
<td>3.22</td>
<td>19.92</td>
<td>63.75</td>
</tr>
</tbody>
</table>

**Chemical reaction**

$$\text{Mg}_2\text{SiO}_4(s) + 4\text{H}^+ \rightarrow 2\text{Mg}^{2+} + \text{H}_4\text{SiO}_4^0$$

**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

Microscopy Images of Granulated Olivine products
Adsorption 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

- 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
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
Applications – Case examples
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/24 hours. 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.

<table>
<thead>
<tr>
<th>Element</th>
<th>Untreated µg/l</th>
<th>Treated µg/l</th>
<th>Removed %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pb</td>
<td>7,0</td>
<td>0,24</td>
<td>97</td>
</tr>
<tr>
<td>Cd</td>
<td>70</td>
<td>2,6</td>
<td>96</td>
</tr>
<tr>
<td>Cu</td>
<td>4000</td>
<td>47</td>
<td>99</td>
</tr>
<tr>
<td>Ni</td>
<td>26</td>
<td>4,1</td>
<td>84</td>
</tr>
<tr>
<td>Zn</td>
<td>25000</td>
<td>490</td>
<td>98</td>
</tr>
<tr>
<td>As</td>
<td>1,0</td>
<td>&lt;0,2</td>
<td>&gt;95</td>
</tr>
</tbody>
</table>

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.
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
Runoff from scrap metal and scrap electronics recycling plant.


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.

<table>
<thead>
<tr>
<th>Elements</th>
<th>Untreated µg/l</th>
<th>Treated µg/l</th>
<th>Cleaning effect %</th>
</tr>
</thead>
<tbody>
<tr>
<td>As</td>
<td>0.43</td>
<td>0.40</td>
<td>7</td>
</tr>
<tr>
<td>Pb</td>
<td>0.98</td>
<td>0.013</td>
<td>95</td>
</tr>
<tr>
<td>Cd</td>
<td>0.14</td>
<td>0.018</td>
<td>87</td>
</tr>
<tr>
<td>Cu</td>
<td>13</td>
<td>0.089</td>
<td>99</td>
</tr>
<tr>
<td>Ni</td>
<td>8.9</td>
<td>5.1</td>
<td>43</td>
</tr>
<tr>
<td>Zn</td>
<td>190</td>
<td>0.63</td>
<td>99</td>
</tr>
</tbody>
</table>
Case: Metallco (Oppland Metall) Norway
Case: Rena is Norway’s newest military base and plays host to several of the Army’s departments.

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.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Concentration “in water”</th>
<th>Concentration after passing the barrier</th>
<th>Treatment efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu</td>
<td>2 200</td>
<td>43,8</td>
<td>98 %</td>
</tr>
<tr>
<td>Zn</td>
<td>100</td>
<td>1,6</td>
<td>98 %</td>
</tr>
<tr>
<td>Ni</td>
<td>7,9</td>
<td>0,42</td>
<td>95 %</td>
</tr>
</tbody>
</table>
## 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.

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

**Blueguard 63**

0,5 cm

**Contaminated soil**

**Draining mix (gravel)**

**Sampling point**

**ACTIVE MATERIALS FOR SOIL MANAGEMENT**

BLUEGUARD 63
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.
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.

The Climate and Pollution Agency (Klif) is Norwegian Ministry of the Environment. Recent years Klif 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 Hjerkin 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.
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.
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
Blueguard 200
20 000 m² x 0,02 m x 1,6 t/m³
= 1200 tonnes

Bentonite AC 200
20 000 m² x 0,02 m x 0,81t/m³
= 400 tonnes

Capping in water
20 decare

Blueguard G1-3
= 100 tonnes

Blueguard 120
8 000 m² x 0,02 m x 1,6 t/m³
= 1400 ton

Bentonite mats
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.
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 take 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.
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 Hjerkkinn 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.

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

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.
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Selling pitches

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

Table 17 Treatment efficiency with lysimeters test. Reactive barrier for runoff from frangible powder. The concentrations are in μg/l.

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<tbody>
<tr>
<td>Cu</td>
<td>2 200</td>
<td>43,8</td>
<td>98 %</td>
</tr>
<tr>
<td>Zn</td>
<td>100</td>
<td>1,6</td>
<td>98 %</td>
</tr>
<tr>
<td>Ni</td>
<td>7,9</td>
<td>0,42</td>
<td>95 %</td>
</tr>
</tbody>
</table>
Sibelco - Åheim
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 vandretningskalk(bygherrelevance)
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

Principskitse af Filterbassin nr. 33

Kote 64,70

- Geotekstil
- 100 cm Kalksten Faxe vandbehandlingskalk
- Tæt bund f.eks. Larmembran
- 20 cm Drænsand / Grus heri nedsættes parallele Dræn Ø100 med c/c 2m. Placering 5 cm over bund. Dræn udsættes med 0% fald

Principskitse af Filterbassin nr. 35

Kote 67,0

- Geotekstil
- 50 cm Kalksten Faxe vandbehandlingskalk
- Tæt bund f.eks. Larmembran
- 30 cm Olivin granulat blandet 66% (vægt/vægt) Sandblanding
- 20 cm Kalksten Faxe vandbehandlingskalk
- 20 cm Drænsand / Grus heri nedsættes parallele dræn Ø100 med c/c 2m. Placering 5 cm over bund. Dræn udsættes med 0% fald

KOORDINATSYSTEM: Kp2000J
V:\Data\6625_3D_Project\Teknik\Anlæg\Afvanding\6625_8008.dgn

66 HERNING - ÅRHUS
6625 HÅRUP - LÅSBY
Projekt til anlæg - Afvanding
Principskitse af filterbassin nr. 33 og 35
260 m²/skud
April 2013

HBS Tagsted YERD Kontro. NKK Godk. MIAN Tid

Vejdirektoratet
6625-8008
Trin 1. Udgravet bassin med lermembran
Vandbehandlingskalk(bygherreleverance)
Nærbillede af filtermedie 33 % Olivin Blue Guard og 66 % filtersand.
## Sorptionsskema for Olivin Blueguard (bemærk at der er flere typer)

<table>
<thead>
<tr>
<th>REPORT No.</th>
<th>CONTAMINANT</th>
<th>SOLVENT</th>
<th>SORPTIVE OLIVINE QUALITY</th>
<th>CONTAMINANT CONCENTRATION [µg/L]</th>
<th>EFFECTIVE SORPTION [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>4490</td>
<td>Antimony, Sb</td>
<td>Fresh water</td>
<td>Blueguard G1-3 2769</td>
<td>10</td>
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<tr>
<td>4490</td>
<td>Phosphate, PO4²</td>
<td>Fresh water</td>
<td>Blueguard G1-3 2769</td>
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<td>100</td>
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<tr>
<td>4487</td>
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<tr>
<td>4487</td>
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<td>99</td>
</tr>
<tr>
<td>4487</td>
<td>Copper, Cu</td>
<td>Fresh water</td>
<td>Blueguard G1-3 2761</td>
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<tr>
<td>4491</td>
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<td>100</td>
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<td>4489</td>
<td>Arsenic, As</td>
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<td>Blueguard G1-3 2761</td>
<td>10 000</td>
<td>95</td>
</tr>
<tr>
<td>4489</td>
<td>Cadmium, Cd</td>
<td>Fresh water</td>
<td>Blueguard G1-3 2761</td>
<td>10 000</td>
<td>100</td>
</tr>
<tr>
<td>4489</td>
<td>Cobalt, Co</td>
<td>Fresh water</td>
<td>Blueguard G1-3 2761</td>
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<td>100</td>
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<td>Chromium, Cr</td>
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<td>100</td>
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<tr>
<td>4489</td>
<td>Copper, Cu</td>
<td>Fresh water</td>
<td>Blueguard G1-3 2761</td>
<td>10 000</td>
<td>100</td>
</tr>
<tr>
<td>4489</td>
<td>Zink, Zn</td>
<td>Fresh water</td>
<td>Blueguard G1-3 2761</td>
<td>10 000</td>
<td>100</td>
</tr>
<tr>
<td>4489</td>
<td>Antimony, Sb</td>
<td>Fresh water</td>
<td>Blueguard G1-3 2761</td>
<td>10 000</td>
<td>80</td>
</tr>
<tr>
<td>4489</td>
<td>Lead, Pb</td>
<td>Fresh water</td>
<td>Blueguard G1-3 2761</td>
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<td>100</td>
</tr>
<tr>
<td>4489</td>
<td>Nickel, Ni</td>
<td>Fresh water</td>
<td>Blueguard G1-3 2761</td>
<td>10 000</td>
<td>100</td>
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</table>

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

Benytt gjerne følgende kontaktinformasjon for nærmere opplysninger:

**DANSAND A/S**

Peter Svensen
Tel: +45 8682 5811
Mobil: +45 2322 7258
E-mail: psv@dansand.dk
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 drænør.
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
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 fuldscaleprojekter i Norge.
• Norske myndigheder og virksomheder som kunder.
• Norske professorer som anpriser
Kunder/anvendelse:

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