

<b>QUICK SCAN REPORT</b>	<b>Technology name:</b>	<b>Rootzone</b> treatment for oil contamination
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<b>Verification body</b>		<b>Proposer</b>	
Name:	DS Certification	Name:	Transform af 1994 Aps / Danish Rootzone Technology
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Quick scan		Previous quick scan			
Date:	9.9.2013	Yes		Date:	No X

<p><b>Technology description</b></p> <p>The rootzone/filter plant or reed bed is a biological filter, where the biological treatment of wastewater takes place in a soil volume, which is penetrated by roots. The root network is to be established by suitable hydrophyte/reeds like Phragmites Communis/Australis. This structure implies that the wastewater flows horizontal or vertical through the soil mass.</p> <p>Soil is constructed with a specific content of organic material/compost. The organic material will build up colloid structure with surface tension, in the long run organic material will be produced by the reeds.</p> <p>During the wastewater flow, the organic molecule and heavy metals are bound to the soil colloids. The turnover of the organic substances occurs with assistance from a diverse, aerobic and anaerobic, microbial activity in the soil. Heavy metals and phosphorus are in long run transferred to crystal structure and get immobile.</p> <p>The aerobic activity is supplied with oxygen from the plant roots as well as via the surface of the system. Thus aerobic activity is concentrated near the plant roots, while anaerobic activity prevails in some distance from the roots. This mosaic of aerobic and anaerobic pockets provides optimum conditions for a wide range of active microbial organisms. Anaerobic as well as aerobic groups of organisms are required for the required break down of the wastewater constituents and may be compared with the anaerobic and aerobic steps in a biological wastewater treatment system. In supply by soil matrix there will be mesophile condition on the border between aerobic and anaerobic area with specific micro activity (fungi) that can support break down of specific hydrocarbons.</p> <p>In biological treatment plants, the two processes are normally separated. In the root zone/filter system, the above mosaic structure permits all processes to occur in the same soil volume. Soil with a plant cover is known for a very high biological activity. This activity is further enhanced by maintaining a large surface and pore volume within the soil structure. Wetland plant species, in particular reed (Phragmites communis L.) stimulates a high pore volume and in-depth supply of oxygen. When the plant stand is fully developed, the pore volume constitutes 42% of the total volume in the upper 60 cm of the soil. The microbial activity is at the below approximate range:</p>
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Bacteria	ca. 600.000.000 per g soil
Fungi:	ca. 400.000 per g soil
Algae	ca. 100.000 per g soil
Protozoa	ca. 1.500.000.000 per g soil liquid

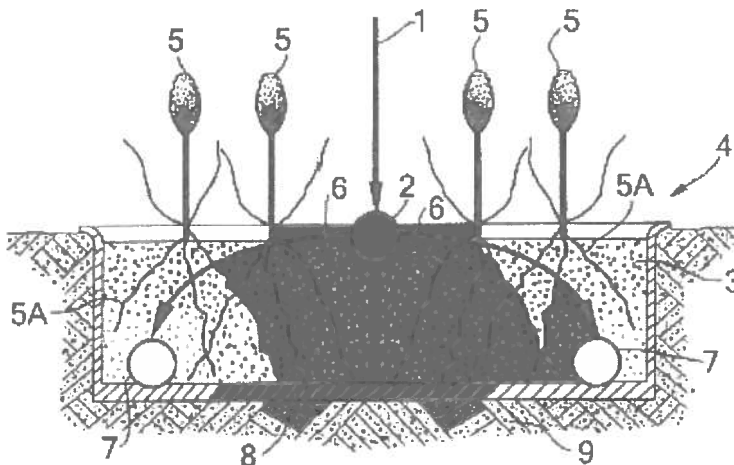
The principle in the root zone method is to activate the microbial processes that actively stimulate the break down of the toxic compounds in a specific wastewater situation.

In root zone plants, the water transport activates aerobic as well as anaerobic processes. This has the effect that a large amount of organic matter is metabolized in a short period of time. This produces metabolites such as organic acids, lactates etc. that stimulate slow down metabolism carbon compound.

The anaerobic metabolic processes are commonly causing development of odorous gases. These gases, however, are absorbed by soil clay particles and colloids, which have high sorptivity and thus hinder bad odors from being released to the atmosphere.

The plant roots creates a horizontal net of pores, which further are connected by star shaped, horizontal root net structures. This net of pores is being conserved and clays soil types and provide hydraulic capacity of the system. Additionally, the evapo-transpiration during the growth season reduces the amount of effluent. The polluting compounds are being concentrated, and the processes are further activated. In a fully developed stand of Phragmites, the evapo-transpiration lies within the range of 6-8 time of pan-evaporation. Under arid condition pan-evaporation gets up to 2-4.000mm or 2-4m<sup>3</sup>/m<sup>2</sup>/year. Evapotranspiration comes up to 12-32m<sup>3</sup>/m<sup>2</sup>/year. At the same time the soil is cooled down. Soil temperature in the reed never gets over 28 degrees Celsius even if sand temperature gets 60 degrees.

Recirculation of contaminated water will support treatment.



Rootzone drawing:

1. Feeding fraction for contaminated water.
2. Perforated feeding pipe or drain
3. Soil filter
4. Section can be supplied with more sections
5. Halophyte vegetation
- 5A. Roots transporting air to the soil
6. Drain curve for water transport
7. Drain pipe for collecting

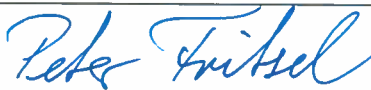
8.	Impermeable liner												
9.	Surrounding soil												
Technology ready to market		Technology in last development phase											
Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>										
Yes	<input type="checkbox"/>	No	<input type="checkbox"/>										
<b>Performance claims</b>													
Matrice(s):	Oil contaminated water and sludge, special from exploration. Reuse of treated water for irrigation. "Greening the Desert"												
Purpose(s):	Bioactive planted soil filter, degradation and sorption of oil compounds												
Vendor claim(s):	<table border="1"> <thead> <tr> <th>Compound group</th> <th>Initial vendor claim</th> </tr> </thead> <tbody> <tr> <td>Oil in water, covering dispersed oil as well as hydrocarbons in water</td> <td>&lt; 5 mg/l in outlet</td> </tr> <tr> <td>BTEX (benzene, toluene, ethyl-benzenes og xylenes)</td> <td>&lt; 1 mg/l in outlet or &gt; 80% removal</td> </tr> <tr> <td>PAHs (16 US EPA PAHs)</td> <td>&gt; 80 % removal</td> </tr> <tr> <td>Phenols</td> <td>&lt; 1 mg/l in outlet</td> </tr> </tbody> </table>			Compound group	Initial vendor claim	Oil in water, covering dispersed oil as well as hydrocarbons in water	< 5 mg/l in outlet	BTEX (benzene, toluene, ethyl-benzenes og xylenes)	< 1 mg/l in outlet or > 80% removal	PAHs (16 US EPA PAHs)	> 80 % removal	Phenols	< 1 mg/l in outlet
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<b>Definitions</b>													
Matrix:	<i>The type of material that the technology is intended for. Matrices could be soil, drinking water, ground water, degreasing bath, exhaust gas condensate etc.</i>												
Purpose:	<i>The purpose should indicate the way the matrix is impacted by the technology and the quantitative parameters suggested for monitoring and documenting the effect</i>												
Initial performance claims	<i>The specifications included in the initial performance claim shall relate to the technology itself and shall be able to be verified using quantitative test methods. The initial performance claim shall state the conditions under which the specifications are applicable, and mention any relevant assumption made. Examples: Monitoring techniques: Include parameters as limit of detection, range of application, precision (repeatability and reproducibility), trueness and relevant robustness can be verified. If relevant, make reference to conventional methods. Treatment technologies: Include relevant treatment parameters as well as other relevant parameters available for verification. If relevant, make reference to conventional methods. Materials: Include all relevant properties, as well as environmental and health impacts, and lifetime. If relevant, make reference to conventional materials.</i>												
<b>Previous tests performed Yes, but not by thirdparty test body</b>													
Test body:													
Test reports provided to the verification body:													

**Evaluation by verification body**

Technology description clear				Performance claims clear			
Yes	X	No		Yes	X	No	

Existing test data							
Tests performed				Test body qualified			
Yes	X	No		Yes		No	X
Test report available				Test report qualified			
Yes	X	No		Yes		No	X
Test methods available				Test methods adequate			
Yes	X	No	X	Yes	X	No	
Raw data available				QA of raw data adequate			
Yes		No	X	Yes		No	X
Performance claims sustained				Performance claims relevant			
Yes	X	No		Yes	X	No	

Conclusions quick scan (incl. estimated cost range for a verification)
The technology is suited for verification.
The cost range is given in the application for funding to the Danish EPA.

Date	Name	Signature
2013-09-13	Peter Fritzel	

**DS Certificering A/S**

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