Composition of biomix and effects on pesticide leaching tested by sorption and column experiments.

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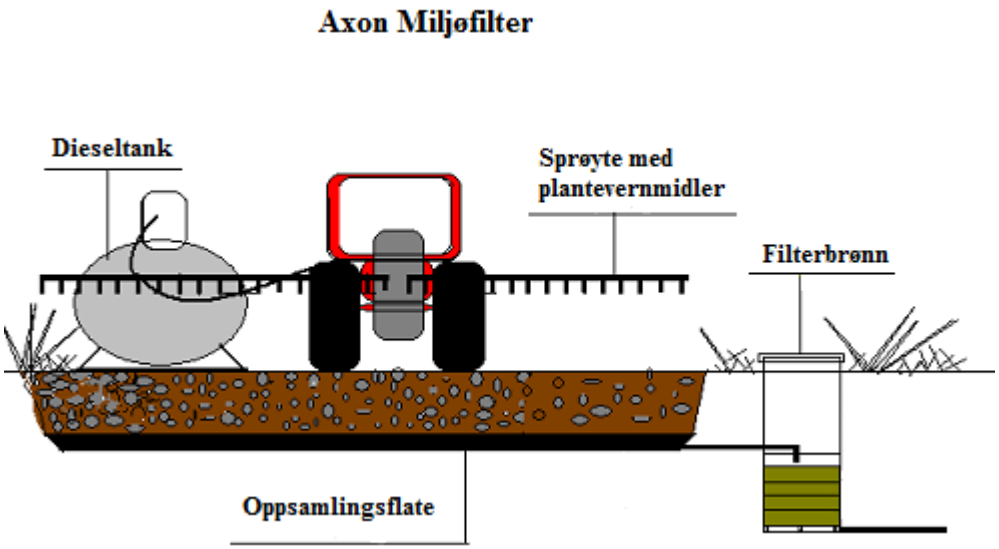
Development objective

- Reduced pollution of oil and pesticides from pointsources in agriculture by developing bioactive filters



Project objective

- Identification of filtermaterials with good retention of pesticides and hydrocarbons
- Identification of combinations of filtermaterials in layers to retain pesticides and hydrocarbons

Activities

- Sorption experiments with the selected pesticides and materials
- Leaching study with short (20-50cm) columns
- Leaching study with long (100cm) columns

Pesticides tested

	Common name	Active ingredient	Mobility	Degradation
Fungicides	Teldor	fenhexamid	moderate	non-persistent
	Candit	kresoxim-methyl	moderate	moderately persistent
	Apron XL	metalaxyl	slightly mobile	moderately persistent
Insecticides	Pirimor	pirimicarb	moderately mobile	moderately persistent
	Signum	pyraclostrobin	not mobile	moderately persistent
		boscalid	slightly mobile	persistent
	Perfekthion	dimetoate	mobile	Non-persistent
Herbicides	MCPA 750	MCPA	mobile	Non-persistent
	Sencor	metribuzin	mobile	Non-persistent
	Basagran SG	bentazone	mobile	persistent

Granulated peat

- Termic treated peat
- No additives
- Density 0.2-0.4 kg/L

Compost

Chemical analysis	
Dry matter	217 g/L
Density	555 g/dm^3
pH	6.8
Particle size	<10 mm
Phosphorus	9.6mg/L
Potassium	195 mg/L
Manganese	210 mg/L
Sodium	310 mg/L
Sulfur	94 mg/L

Rice Husk Ash (RHA)

1. Chemical analysis

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%	H2O	0,4				
%	LOI975	5,87		ppmw	Mn	1156
%	SiC	2,05		ppmw	Cd	<10
%	C	5,25		ppmw	Mo	<10
%	Colour	8,3		ppmw	Zr	29
Kg/dm3	Bulk d.	0,37		ppmw	Sr	32
%	+0.045mm	40,0		ppmw	Pb	115
-	pH	9,8		ppmw	Br	55
m2/g	Sp.surf.	34,5		ppmw	As	<10
Kg/dm3	S.G.	2,21		ppmw	Ga	41
%	Pozzolan	77		ppmw	Zn	118
%	SiO2	87,9		ppmw	Cu	32
%	Fe2O3	0,39		ppmw	Ni	<10
%	Al2O3	0,28		ppmw	Co	<10
%	CaO	0,84		ppmw	Cr	149
%	MgO	0,32		ppmw	V	<10
%	Na2O	0,03		ppmw	La	14
%	K2O	2,28		ppmw	Ti	115
%	P2O5	>0,23		ppmw	Ba	67
%	SO3	0,28		ppmw	I	30
%	Cl*	0,34		ppmw	Sn	24

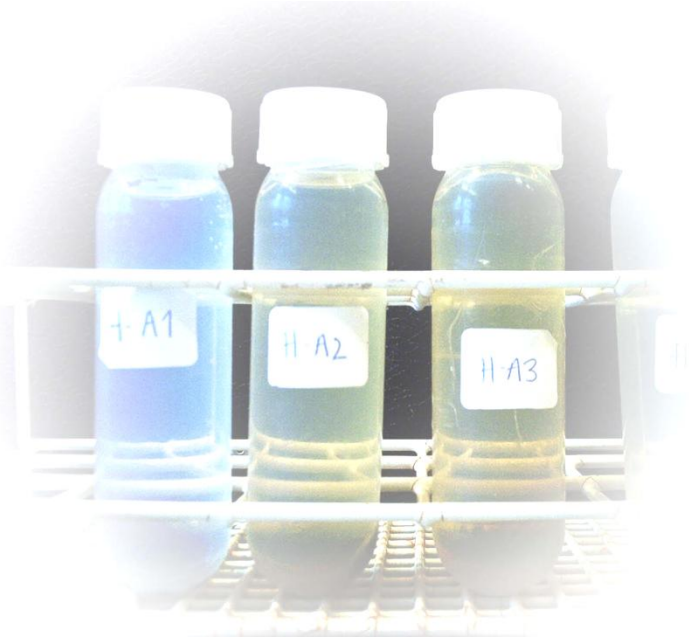
Elkem Materials

Microsilica

Properties	Limits
SiO_2	96.0-99.0%
Carbon	< 0.20%
Fe_2O_3	<0.25%
Moisture	0.80%
Loss of ignition	<0.60%
Coarse particles	<0.10%
pH	7-9
Bulk density	400-700 kg/m^3
Specific surface area	20 m^2/g
Median particle size	0.15µm
Density	2.2 g/cm^3

Sorption studies

- Filter material – 5g
- $CaCl_2$ 25 ml 0.01M
- Shaking 24 hours
- 50 mg/L pesticide a.i
- OECD guidelines 106



Column experiment (I)

- Steel columns (50cm)
- 2x porevolum water (4 L)
- Filter thickness 40 cm
- 0.2 g a.i. pesticide

Column experiment (II)

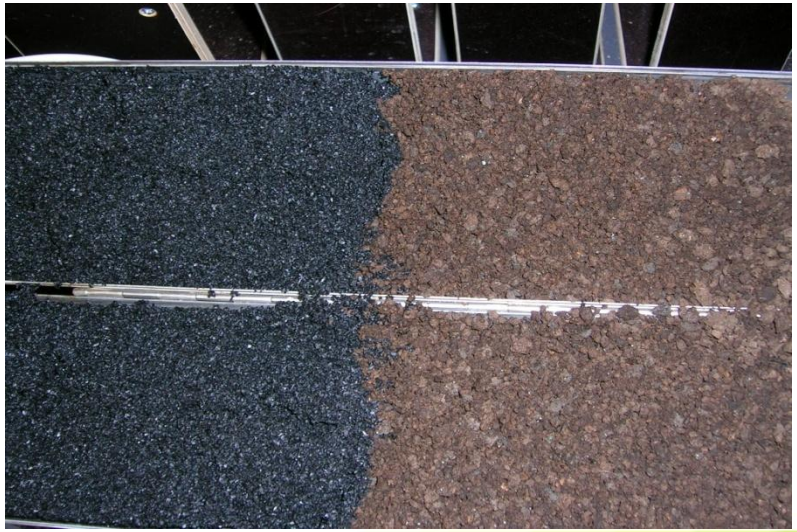
- Steel column (100 cm)
- 2x porevolume water (6 L)
- Thickness filter (80 cm)
- 0.06 g a.i. pesticide

Sorption test

Percent pesticides adsorbed to the different filter materials

	Peat	Compost	Active Carbon	Rice Husk Ash	Microsilica
MCPA	89 %	43 %	98 %	100 %	0 %
Metribuzin	90 %	69 %	100 %	100 %	14 %
Bentazone	73 %	15 %	97 %	100 %	0 %
Fenhexamid	99 %	98 %	100 %	100 %	0 %
Kresoxim-methyl	99 %	98 %	99 %	100 %	97 %
Metalaxyl	90 %	64 %	99 %	100 %	6 %
Pirimicarb	97 %	68 %	97 %	100 %	11 %
Pyraclostrobin	100 %	100 %	99 %	100 %	98 %
Boscalid	99 %	98 %	95 %	100 %	94 %
Dimethoate	92 %	71 %	100 %	100 %	32 %

Column test (I)



Percentage of pesticides leached from the columns (50 cm)

	Peat + rice husk ash + compost	Peat + active carbon+compost	Active carbon
MCPA	0.1 %	0.1 %	0.0 %
Bentazone	4.5 %	0.1 %	0.0 %
Dimetoate	9.6 %	0.1 %	0.0 %
Pirimicarb	6.6 %	0.1 %	0.0 %
Metribuzin	7.8 %	0.2 %	0.0 %
Metalaxyl	1.8 %	0.1 %	0.0 %
Fenhexamid	1.0 %	0.1 %	0.0 %
Kresoximmethyl	0.5 %	0.2 %	0.0 %
Pyraclostrobin	0.1 %	0.0 %	0.0 %
Boscalid	-	0.0 %	-

Percentage of pesticides leached from the columns (100 cm) with top and bottom layer of peat

	Rice husk ash + peat (1:3)	Rice husk ash+ peat(1:2)	Rice husk ash + peat (1:3), compost + peat (1:2)	Rice husk ash + peat (1:2), compost + peat (1:2)	Active carbon
MCPA	120.2 %	80.4 %	56.3 %	93.3 %	0.0 %
Bentazone	146.1 %	148.7 %	156.3 %	175.7 %	0.0 %
Dimetoate	14.2 %	6.9 %	3.1 %	7.4 %	0.0 %
Pirimicarb	0.0 %	0.3 %	0.0 %	0.1 %	0.0 %
Metribuzin	5.4 %	7.8 %	1.0 %	5.1 %	0.0 %
Metalaxyl	9.9 %	8.9 %	1.8 %	8.3 %	0.0 %
Fenhexamid	0.0 %	0.1 %	0.0 %	0.0 %	0.0 %
Kresoximmethyl	0.2 %	1.4 %	0.0 %	0.0 %	0.0 %
Pyraclostrobin	0.0 %	0.0 %	0.0 %	0.0 %	0.0 %
Boscalid	2.8 %	5.0 %	0.8 %	0.9 %	0.0 %

Conclusions:

- Active carbon confirm to be a suitable filter material – both sorptive and hydrological but expensive
- Anionic substances is the most difficult substances
- Rice Husk Ash is a promising filter material with improvement of the dispersion of the leachate
- Compost with better hydrological properties should be tested
- Effects of detergent and additives should be tested
- Microsilica is not a suitable filter material

Acknowledgement

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