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Pilot study with fly ash stabilised sewage sludge (FSS) as hydraulic barrier layer in top cover constructions

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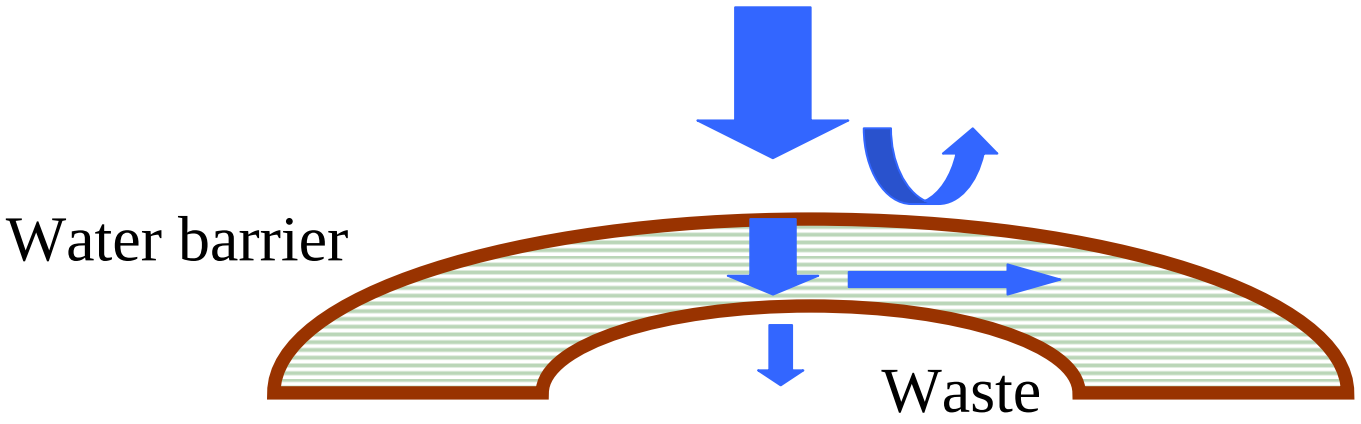
Landfill cover needs in Sweden

- 1 900 ha
- Material needs
- Alternative material – new possibilities
- 4500 ton sewage sludge/ha

Function of the top cover



Requirement < 50 liter/m^2 and year (mm / y)

Aim of the project

- Investigate if FSS is a suitable liner material in landfill top cover
  - Hydraulic conductivity of FSS-cover
  - Demonstrate the feasibility
  - The sustainability of the barrier

Critical factors

- Hydraulic conductivity
- Degradability
- Shear strength
- Feasibility

Chemical characterization

– *Electrical conductivity (SIS 028123)*

– *pH (SS 028122)*

– *TOC – Total Organic Carbon (SS-EN 1484)*

– *Anaerobic and aerobic degradation*

Degradation tests

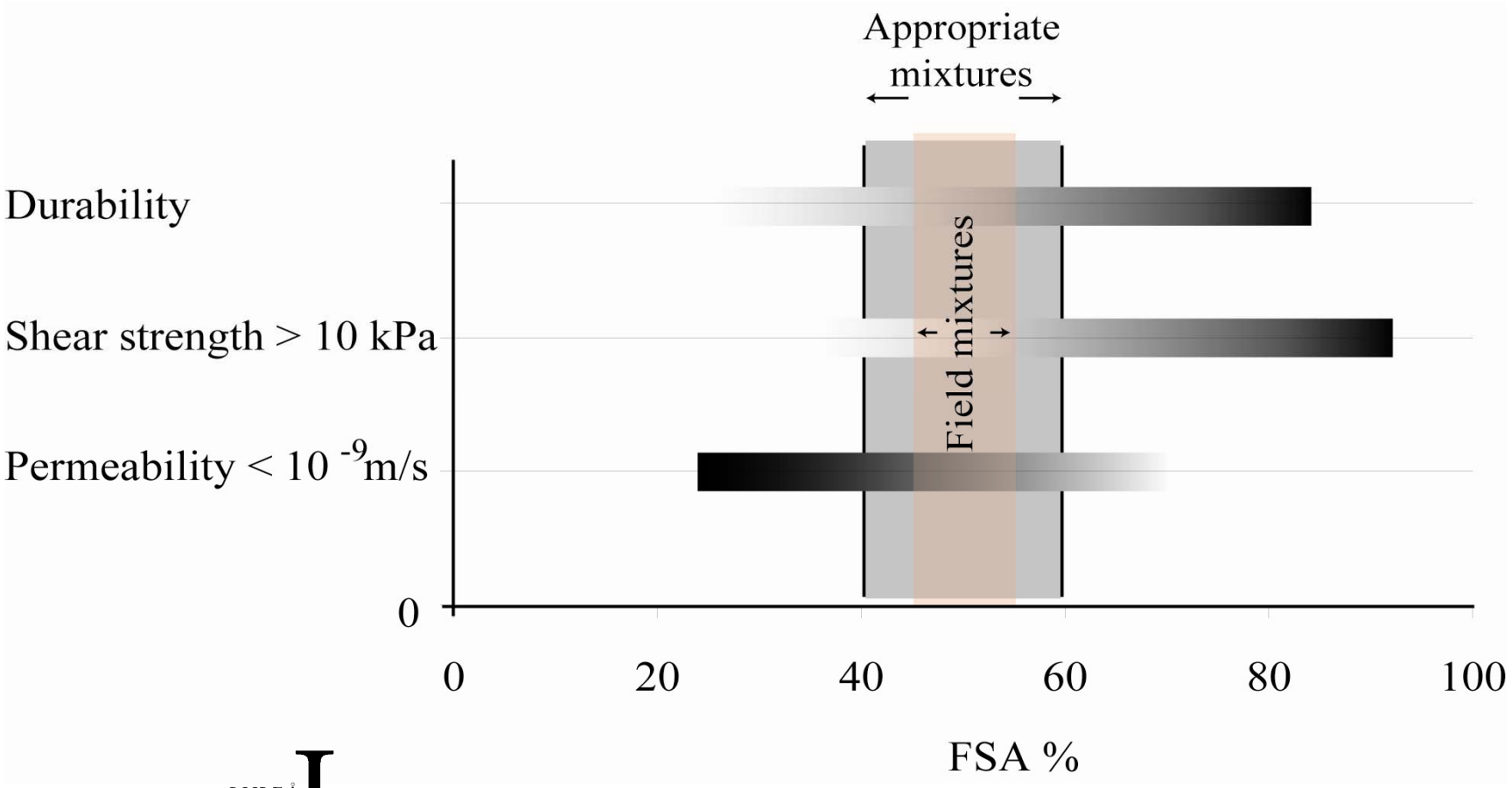
– ***BMP-test (anaerobic):***

$C_6H_{12}O_6 \longrightarrow 3\,CO_2 + 3CH_4$

– ***Respiration test (aerobic):***

$C_6H_{12}O_6 + 6\,O_2 \longrightarrow 6\,CO_2 + 6\,H_2O$

Optimal mixture



Variation of the Material Quality

Sludge

	TS %
Variation	**28 - 37**
Median	**31.5**

Fly ash

	TS %
Variation	**68 - 94**
Median	**77 - 87**

The mixing quality

The homogeneity of FSS-material is crucial

- Incoming material
- Premixing
- Mixing

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Installation

Gas sampling in the field

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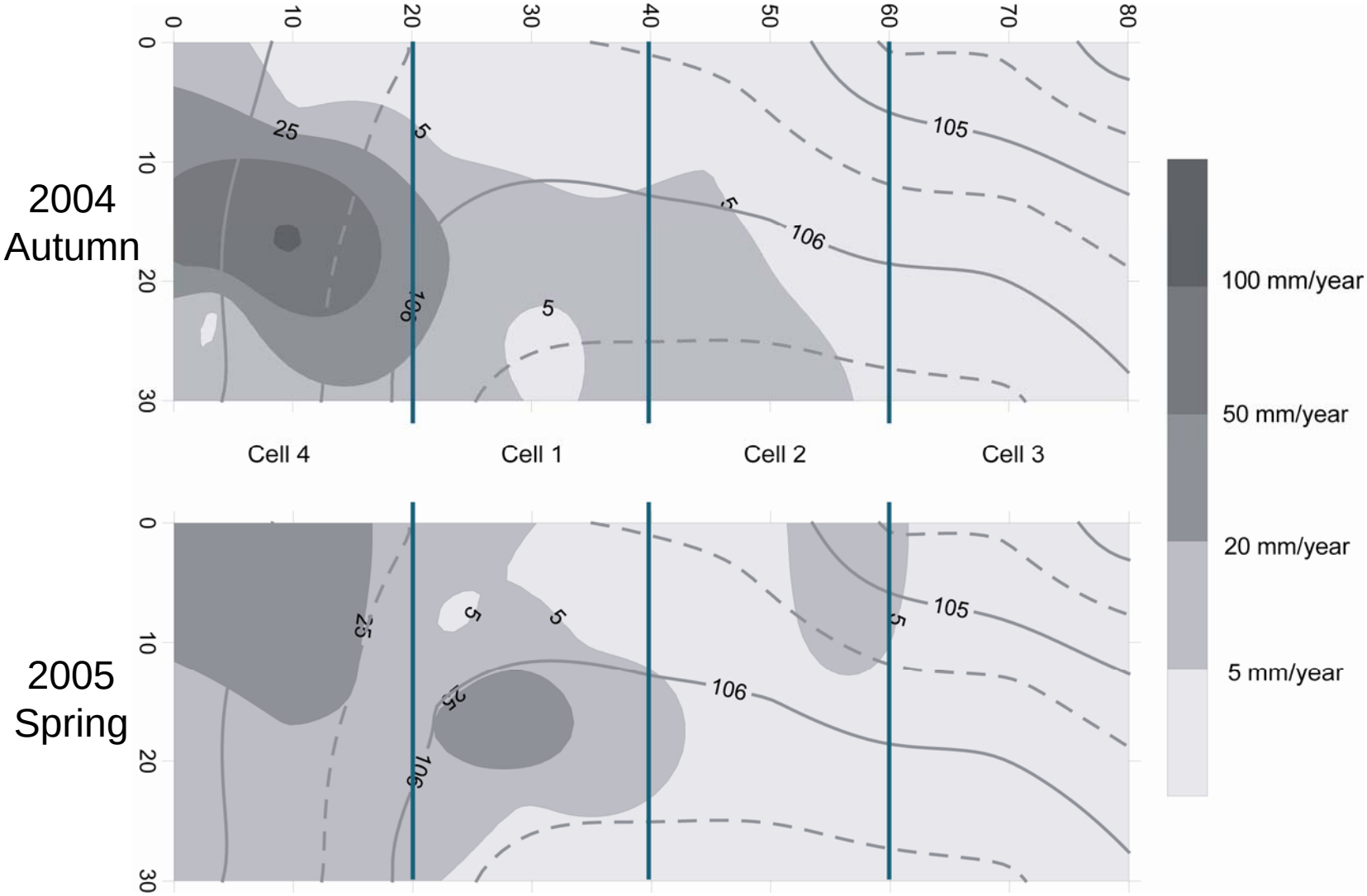
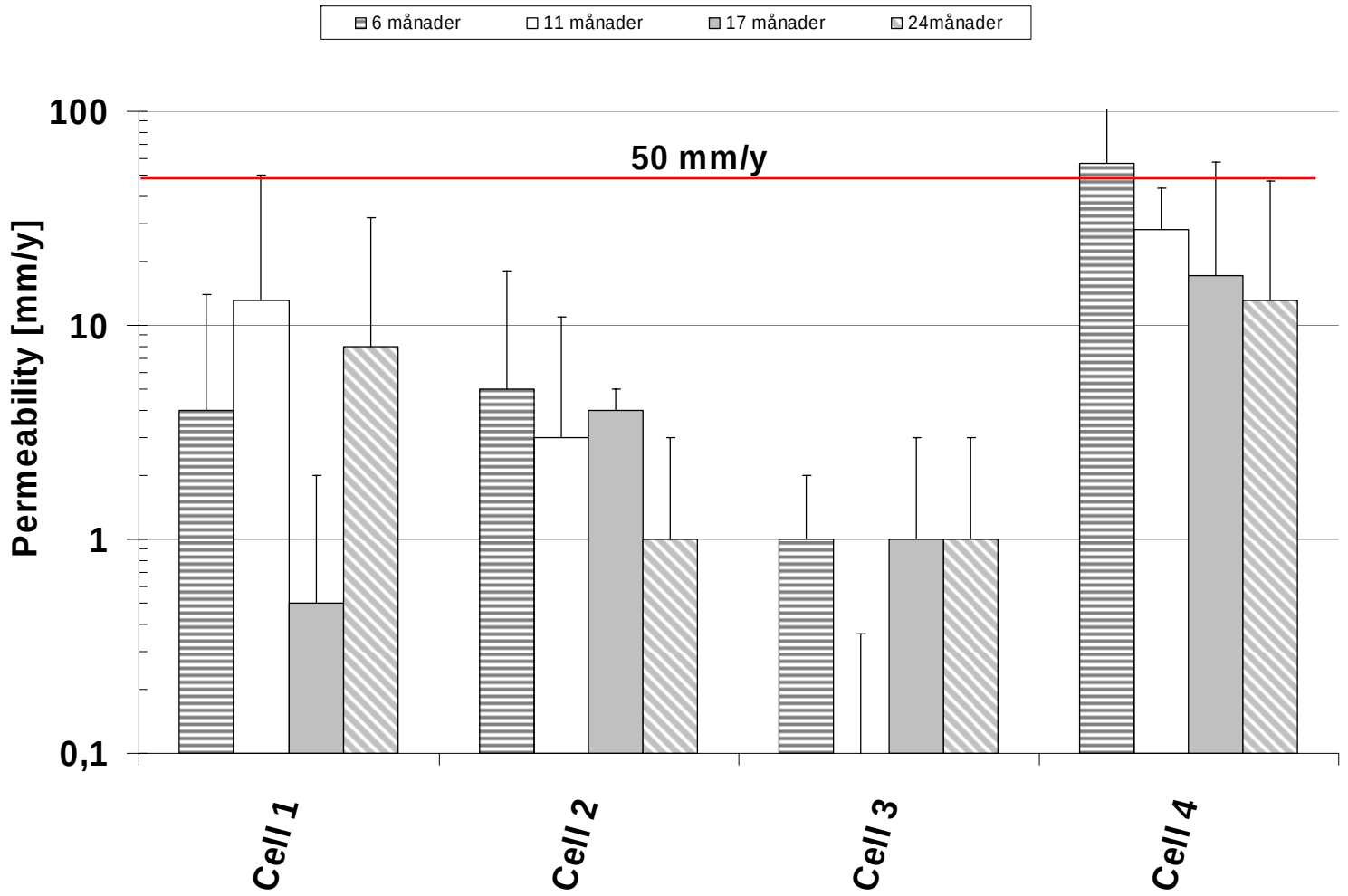
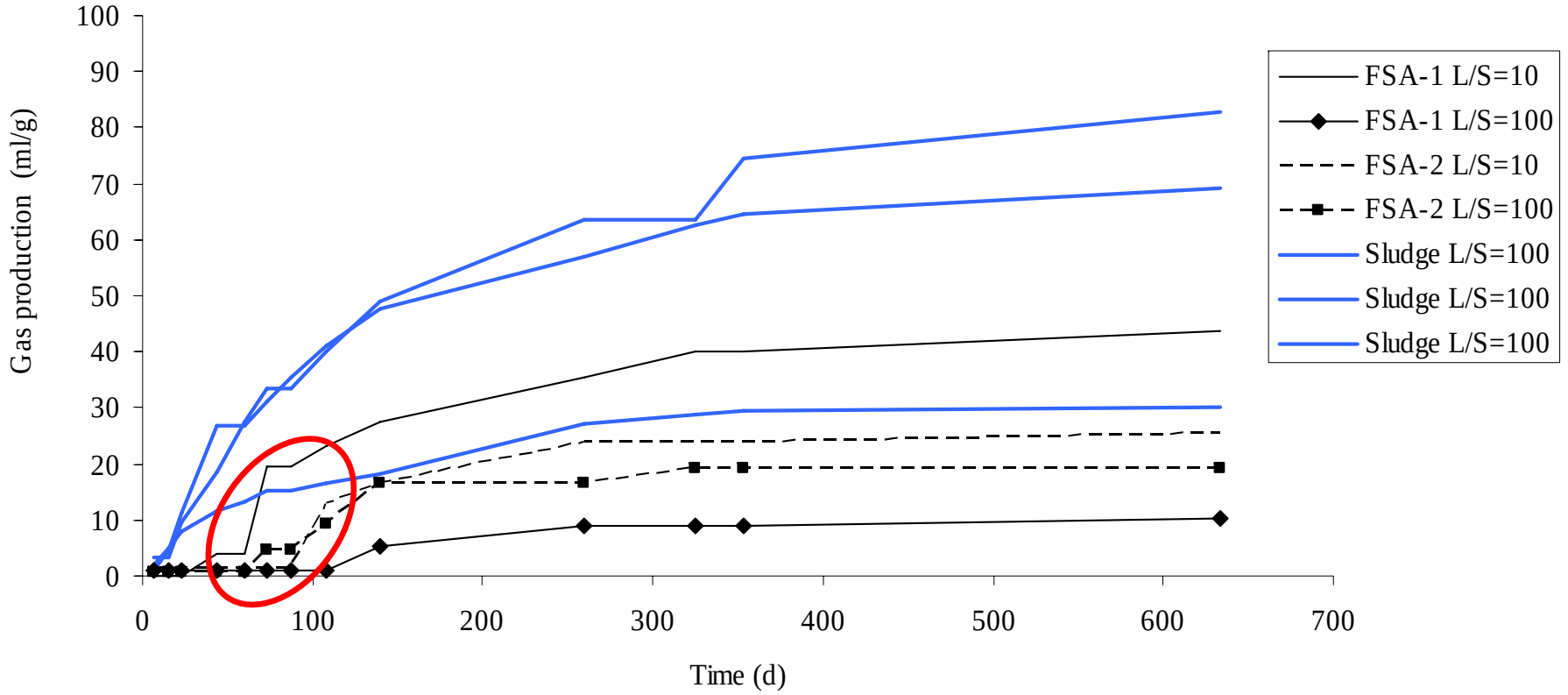
Water infiltration



Water percolation, average



Gas production in anaerobic degradation of FSS 1 and 2 (40% ash) after leaching at L/S 10 and 100 and sludge



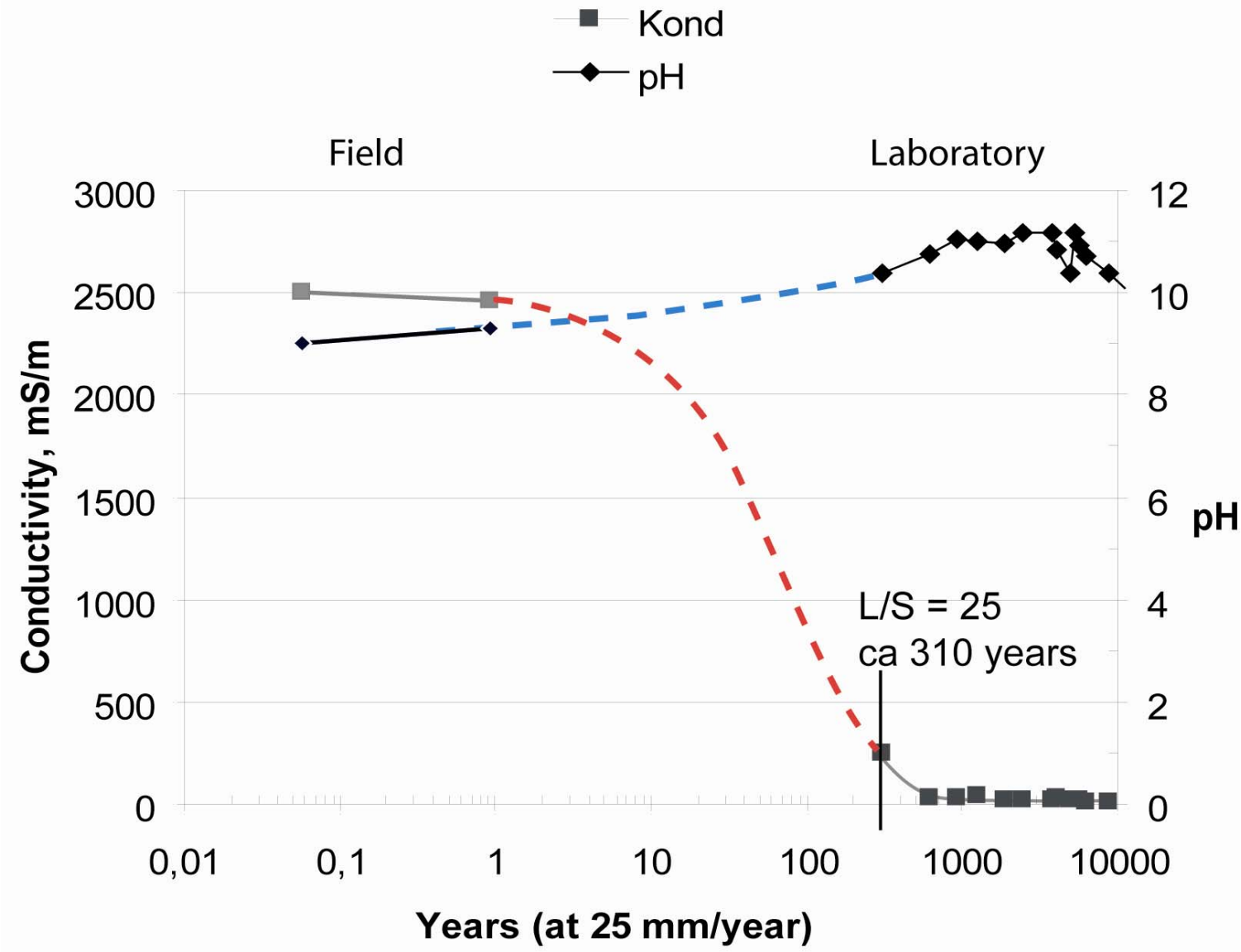
No gas production was observed …

… in FSS mixture with 60% ash.

… at L/S 2 and 10 when the first leachate was not removed.

High pH and salt content is believed to inhibit the microbiological activity.

Long term behaviour



Assessment of long term stability

assuming layer thickness 0.55 m and dry density 533 kg/m^3

Percolation Liter/m^2 year	L/S 1 y	L/S 10 y	L/S 25 y	L/S 100 y
5	62	620	1557	6226
10	31	310	778	3113
50	6	62	156	623
100	3	31	78	311

TOC in leachate

Sample	TOC [mg/l]	TOC %-mass FSS	TOC %-mass sludge
Ash 1 40% L/S 10	796	2.0	3.3
Ash 1 40% L/S 100	89	2.2	3.7
Ash 1 60% L/S 10	733	1.8	4.6
Ash 1 60% L/S 100	74	1.8	4.6
Ash 2 40% L/S 10	829	2.1	3.5
Ash 2 40% L/S 100	92	2.3	3.8
Ash 2 60% L/S 10	734	1.8	4.6
Ash 2 60% L/S 100	73	1.8	4.1
Sludge L/S 100	127	3.2	3.2

Degradation

	Gas production ml	Degradation %-mass sludge
FSS 1 L/S=10	241	5.4
FSS 1 L/S=100	53	1.2
FSS 2 L/S=10	144	3.2
FSS 2 L/S=100	115	2.6
Sludge L/S=100	288	3.9
Sludge L/S=100	625	8.4

Conclusions

- FSS fulfils the requirements for the barrier
- No degradation was observed at high content of ash in stagnant water

- 4-8 % of the sludge degrades and 3-4 % of the organic material leaches out (TOC)