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In-Situ Aeration - a Cheap Method for Landfill Remediation




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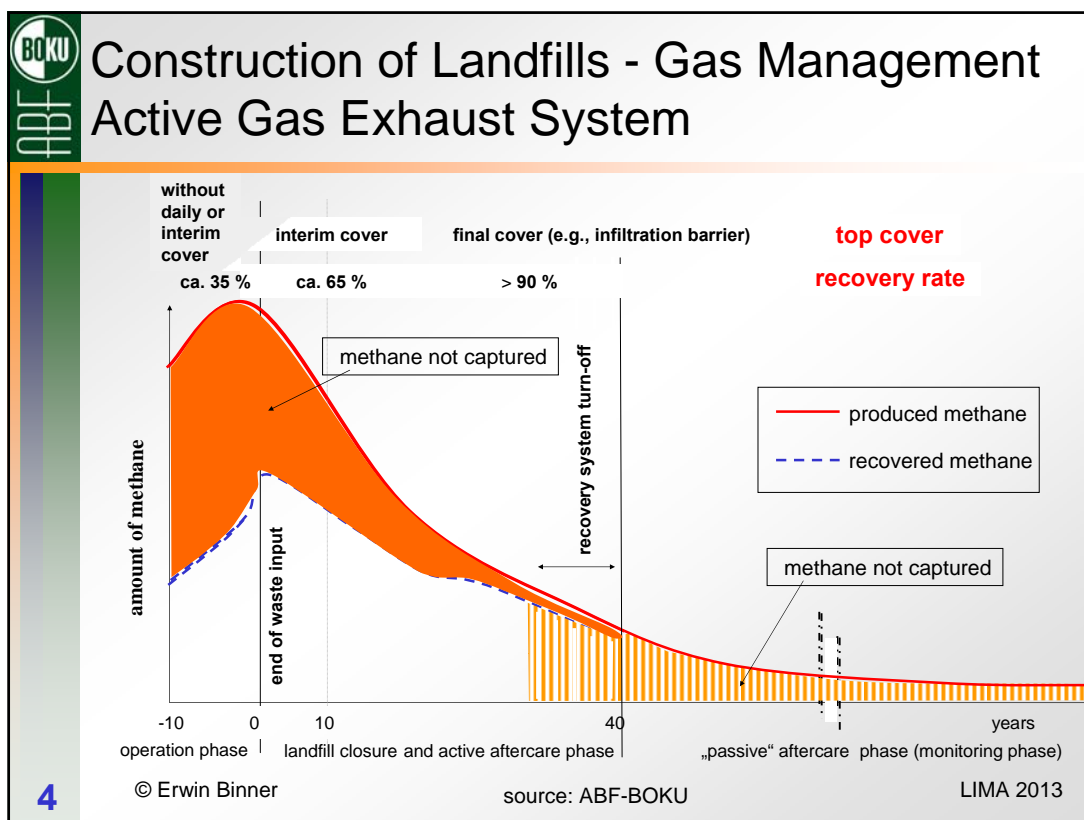
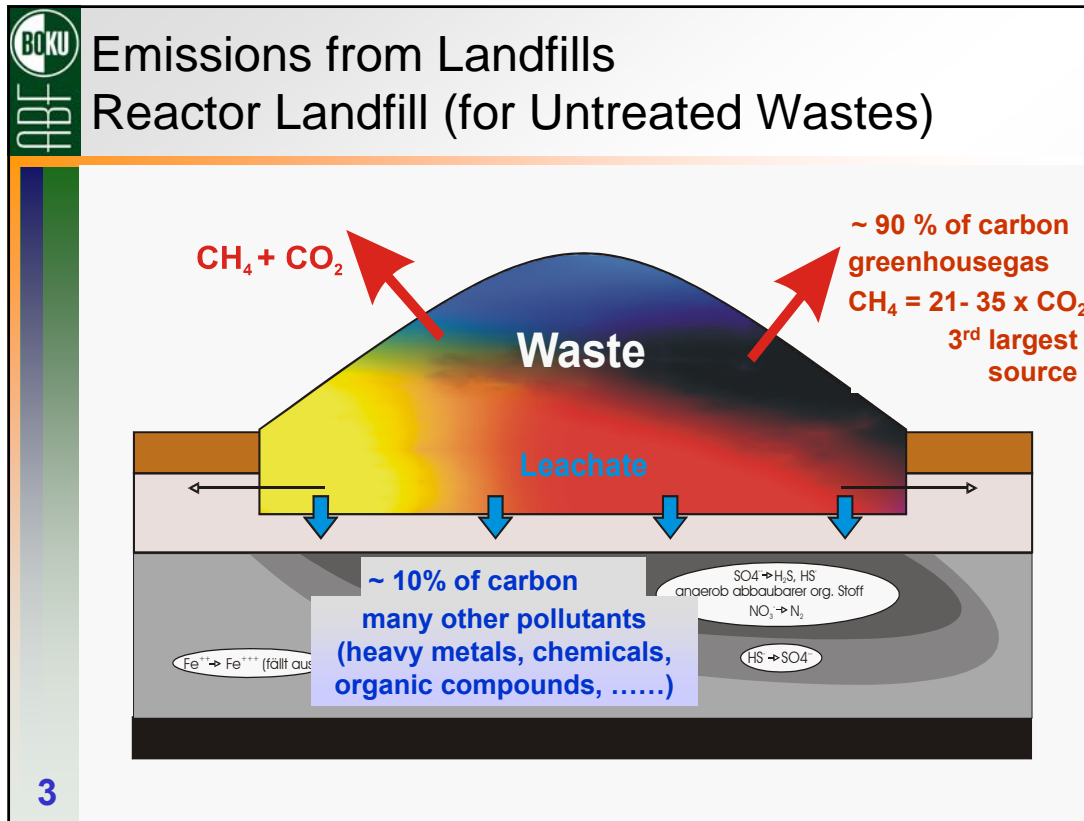
Outlook

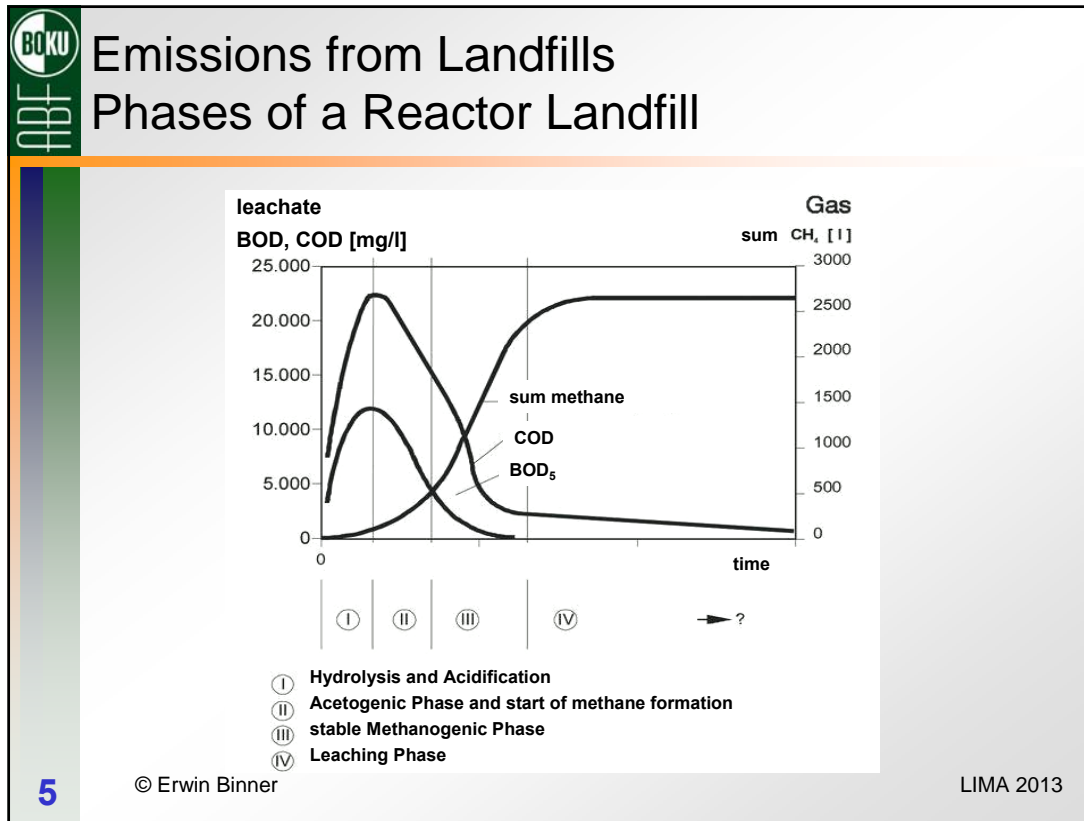
- Emissions from Landfills
 - Landfillgas
 - Leachate
- Evaluation of Landfill Status
- Remediation of Landfills
 - Digging Out
 - In-Situ Aeration

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Emissions from Landfills Leachate

parameter	unit	fermentative-anaerobic phase "Acidogenic Phase"		stable methane phase "Methanogenic Phase"	
		range	average	range	average
pH	---	4.5 – 7.5	6.1	7.5 – 9	8
COD	mg/l	6,000 – 60,000	22,000	500 – 4,500	3,000
BOD ₅	mg/l	4,000 – 40,000	13,000	20 – 550	180
Ca	mg/l	10 – 2,500	1,200	20 – 600	60
SO ₄	mg/l	70 – 1,750	500	10 – 420	80
Zn	mg/l	0.1 – 120	5	0.03 – 45	0.6
Fe	mg/l	20 – 2,100	780	3 – 280	15

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Emissions from Landfills
Leachate


		fermentative-anaerobic phase "Acidogenic Phase"	stable methane phase "Methanogenic Phase"
parameter	unit	range	average
Total N	mg/l	50 – 5,000	1,350
NH ₄ -N	mg/l	30 – 3,000	750
Chloride	mg/l	100 – 5,000	2,100
Pb	mg/l	0.008 – 1.02	0.09
Cd	mg/l	0.0005 – 0.14	0.006
Cr	mg/l	0.03 – 1,6	0.3
Cu	mg/l	0.004 – 1.4	0.08
Ni	mg/l	0.02 – 2.05	0.2
AOX	µg/l	320 – 3,350	2,000

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Emissions from Landfills
Organic Matter in Leachate


"Acidic Phase"
95 % of TOC are low carbon acids, i.e. substances with low molecular weight (< 100 g/mol)
only a low percentage of substances with a high molecular weight (>> 1,000 g/mol)

"Methane Phase"
most of TOC are substances with a high molecular weight



BOD₅ is high
 $\frac{BOD_5}{COD} \text{ ca. } 0.5$

easily biological degradable



BOD₅ is low
 $\frac{BOD_5}{COD} \text{ ca. } 0.1$

not easily biological degradable
compounds similar to humic substance

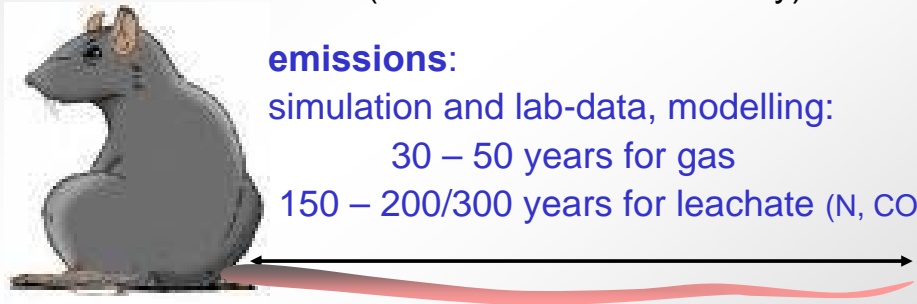
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Landfill Aftercare How Long is the Rattail?

time for active aftercare?
EU-landfill directive: > 30 years
(ensured financial security)

emissions:
simulation and lab-data, modelling:
30 – 50 years for gas
150 – 200/300 years for leachate (N, COD)



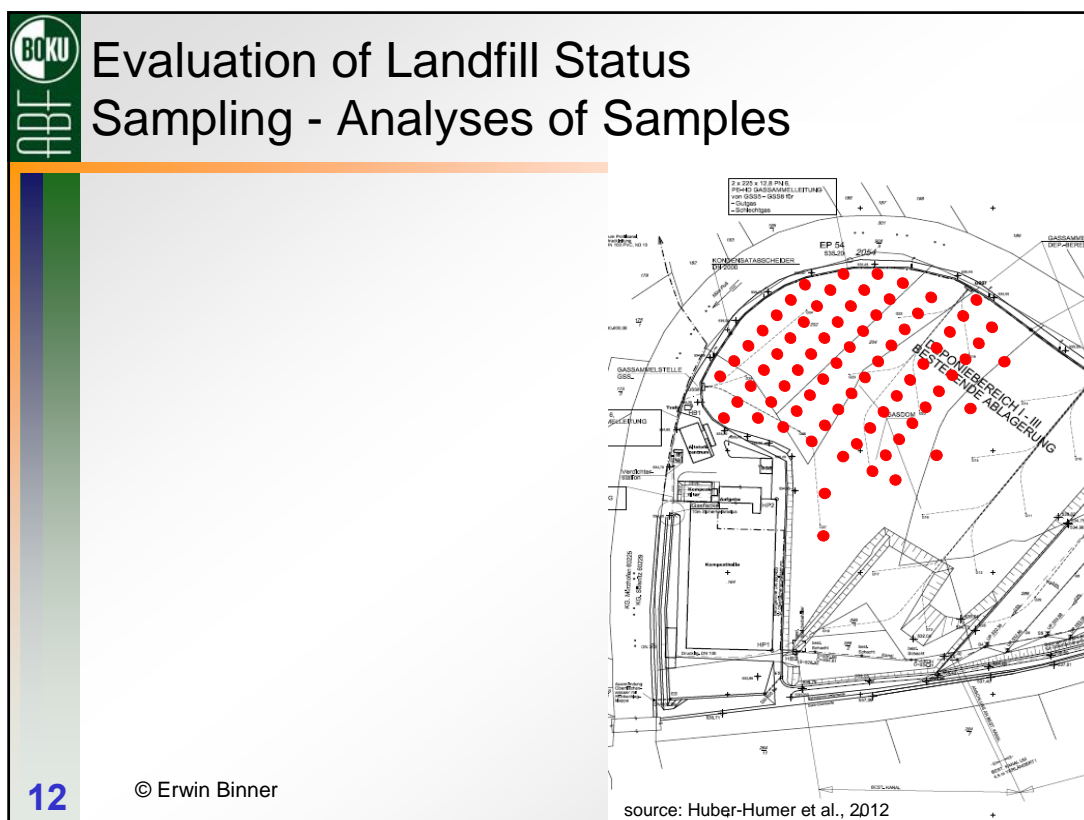
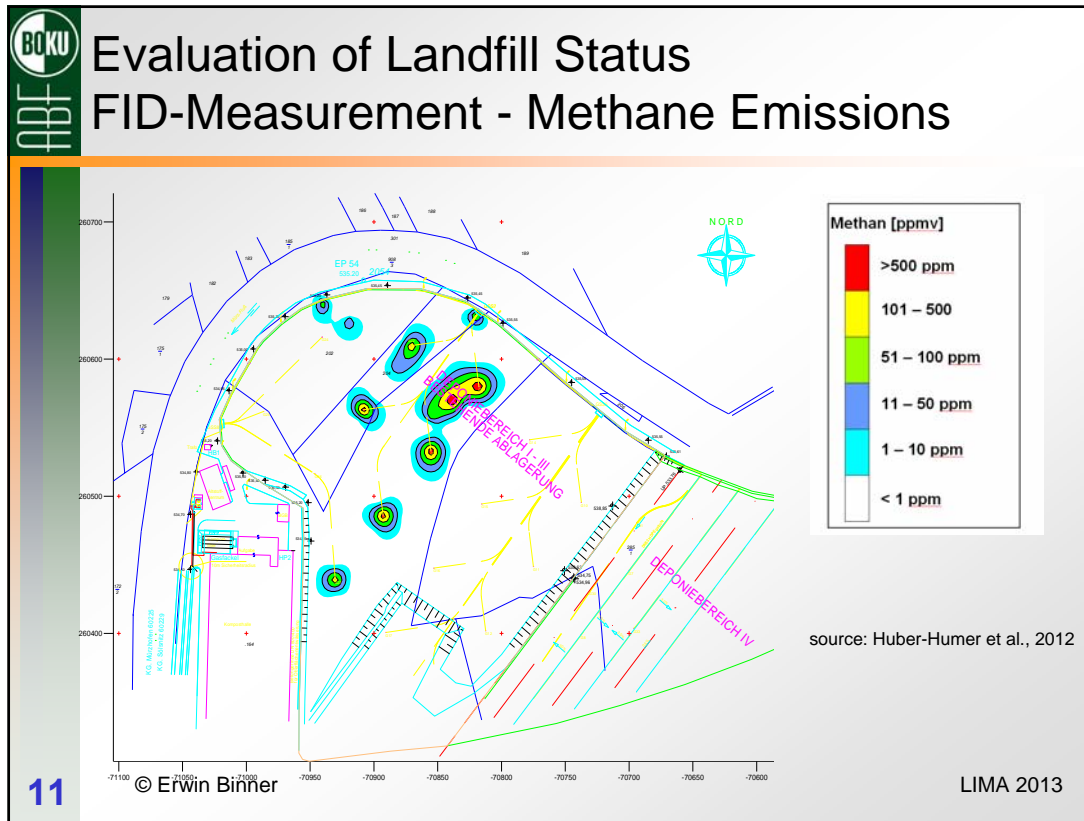
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Pollution by Inadequate Landfilling!



10 photo: Binner, 2001



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Evaluation of Landfill Status Sampling




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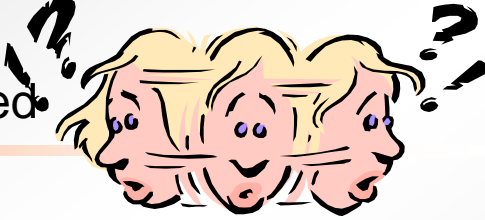
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Evaluation of Landfill Status Sampling



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 Landfill Remediation
Question to be Answered




digging out all the waste???

- emissions during digging
- costs
- how to dispose residues

in situ remediation???

- encapsulation (time frame!)
- immobilisation (how?)
- stabilisation (aeration)

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 Landfill Remediation
In-situ Aeration

stabilisation of waste

- anaerobic process is slow
- lots of compounds not degradable (lignin)
- aerobic process much faster
- enhancing degradation by blowing in air and optimising conditions for aerobic microbes

16 © Erwin Binner → **(M)BT in the landfill site** LIMA 2013

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Landfill Remediation In-situ Aeration / Investigations

lab-scale (LSR)




photo: ABF-BOKU

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pilot-scale





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Landfill Remediation In-situ Aeration / Investigations

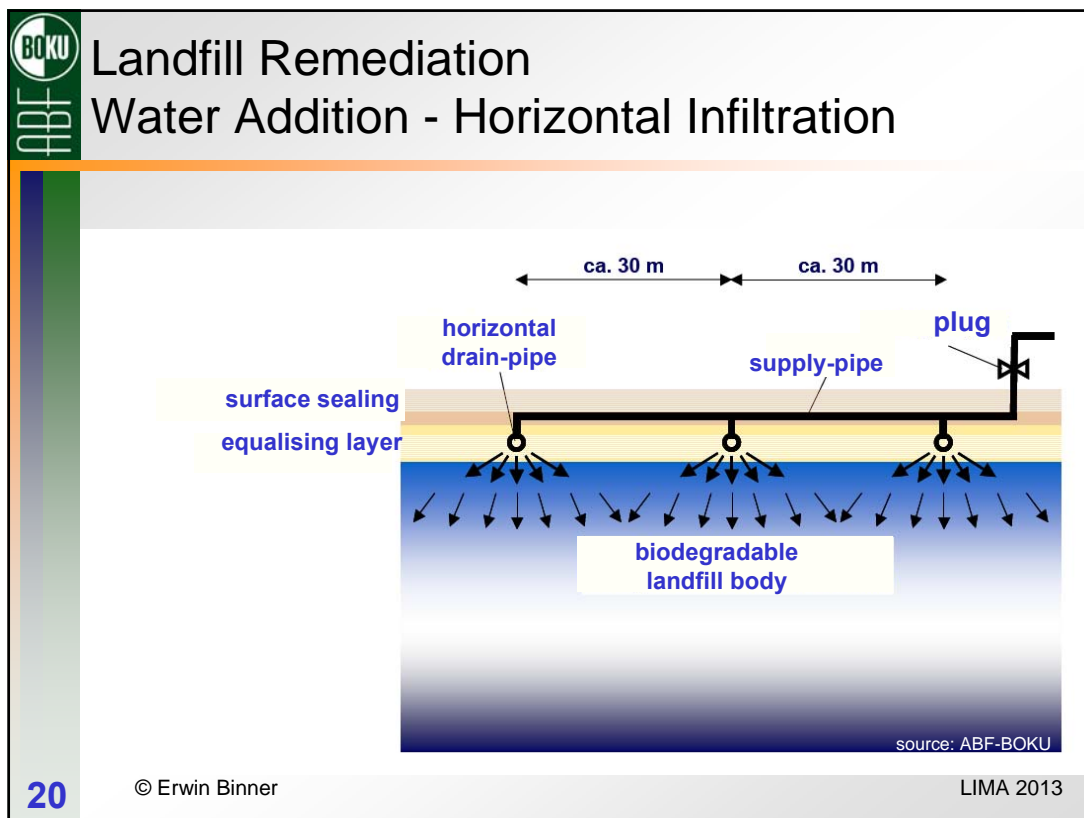
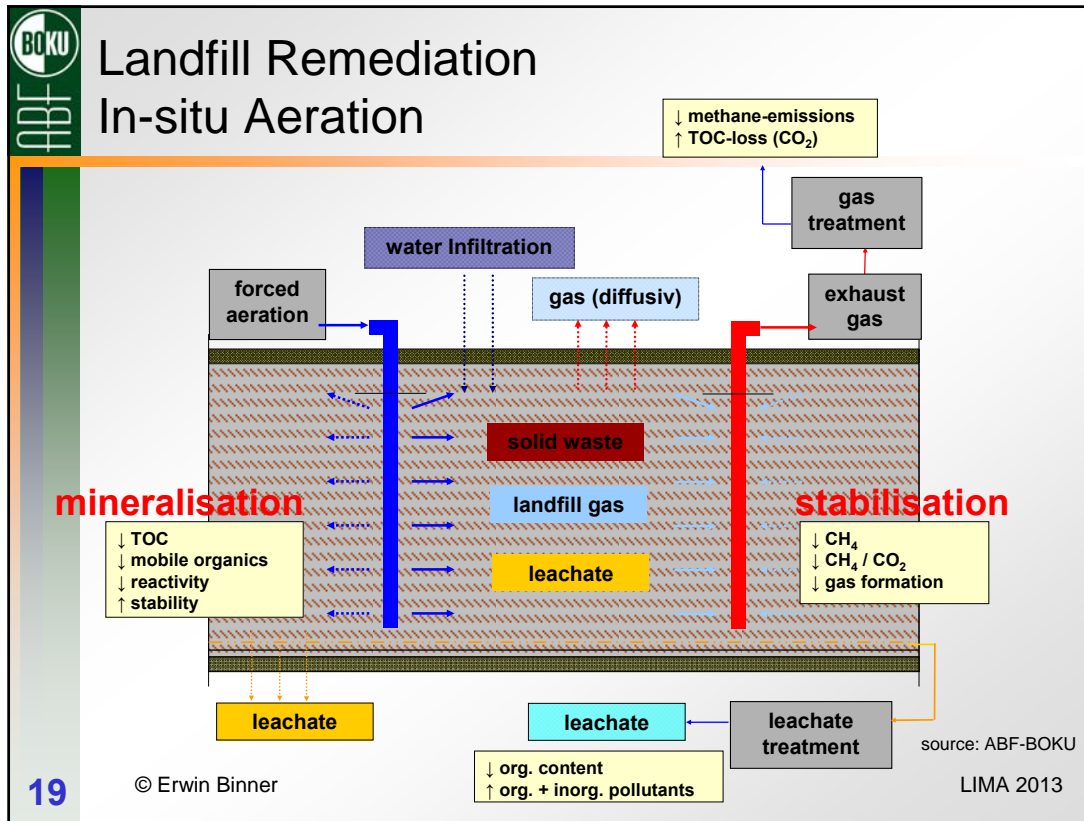


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Landfill Remediation Water Addition - Vertical Infiltration

scheme of a vertical infiltration lan

water tube or pipe
water meter
plug
lance
surface sealing
equalising layer
biodegradable landfill body
ca. 1 - 2 m

source: ABF-BOKU
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Landfill Remediation In-situ Aeration / Results and Conclusions

- In-Situ aeration is possible and effective also to remediate **rather old MSW-landfills (> 25 years)**
- **cost effective** remediation technology (2 - 5 Euro / m³)
- proposed remediation **duration**: 4 - 6 years
- monitoring the quality of the aerated waste material is suitable for **process control**
- identification of **most suitable parameters** for process control: BOD, COD, NH₄-N, RA₄ and infrared spectroscopy
- definition of **target values** for properties of solid waste material, leachate and the exhaust gas

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