Landfill Mining:
An Option to Trigger Resources?

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Circular Economy Meets Energy Union
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Quelle: www.propubs.com/industries/global-landfill-mining/conferences/introduction

Content

Introduction

Introduction

Project structure

Bundesministerium für Bildung und Forschung

Projektträger Jülich Forschungszentrum Jülich

- Funding from Federal Ministry of Education and Research
- Program
  „r³ – Innovative Technologies for Resource Efficiency – Strategic Metals and Minerals“
- Project period: August 2012 – July 2015
- Project partners
  - Companies
  - Universities
  - Institutes

TÖNSMEIER AML

Technische Universität Braunschweig

TU Clausthal

RWTH AACHEN UNIVERSITY

Öko-Institut e.V. Institut für angewandte Ökologie Institute for Applied Ecology

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Introduction

Ambition & Approach

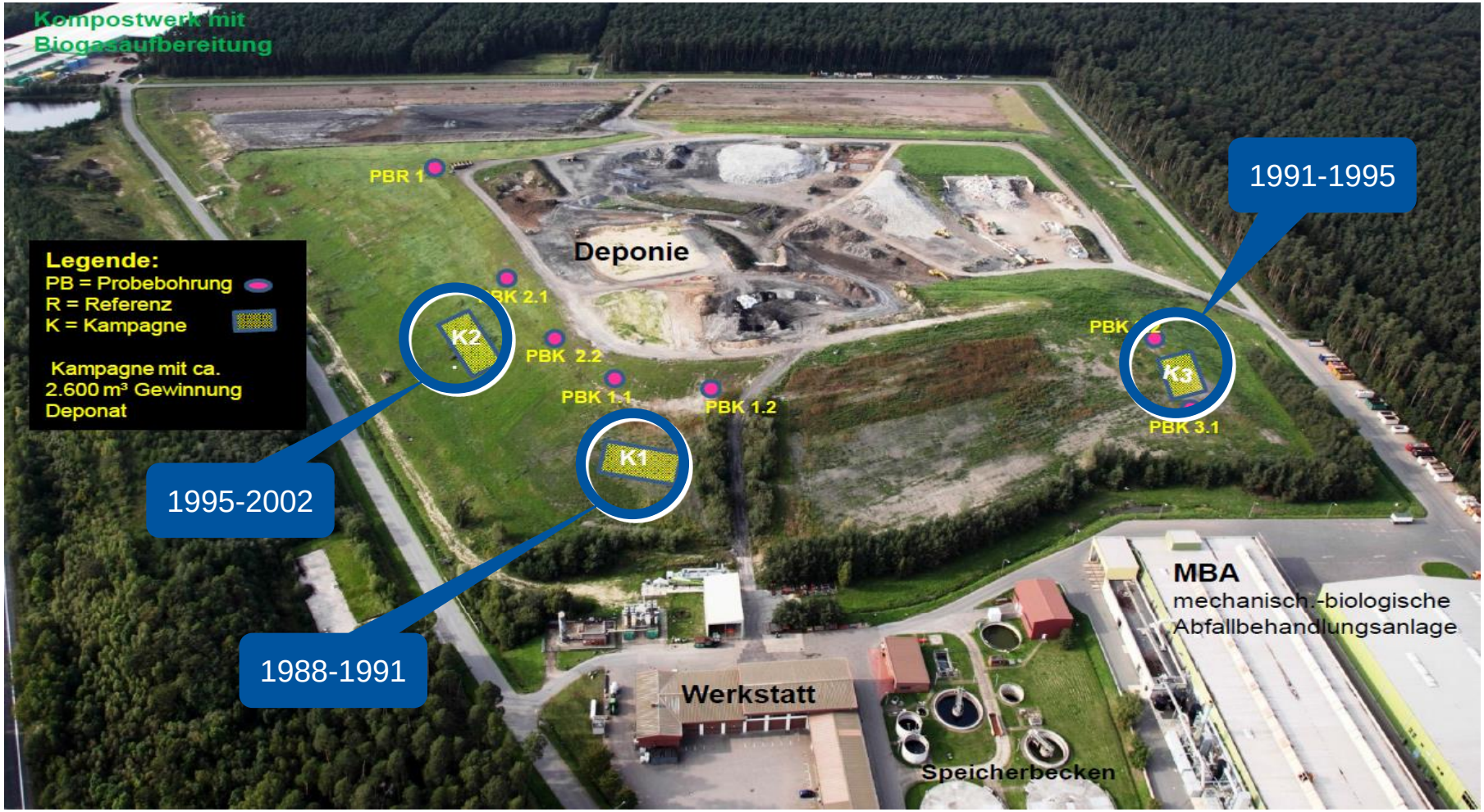
- Development of methods for recovery of selected resources from municipal waste and slag landfills
- Excavation and treatment of 8,000 Mg old-deposit (80s to 2010s)
- Study on landfill reclamation and resource usage:
  - Technology
  - Ecology
  - Economy
- Preparation of guidelines for the implementation of landfill mining projects

- Our task
  - Thermal recycling of RDF-fractions generated from landfill material
  - Pyrolytic treatment of mechanically generated metal concentrates (disintegration of composite material)

RDF-Production

Landfill material excavation

Landfill Pohlsche Heide District Minden-Lübecke



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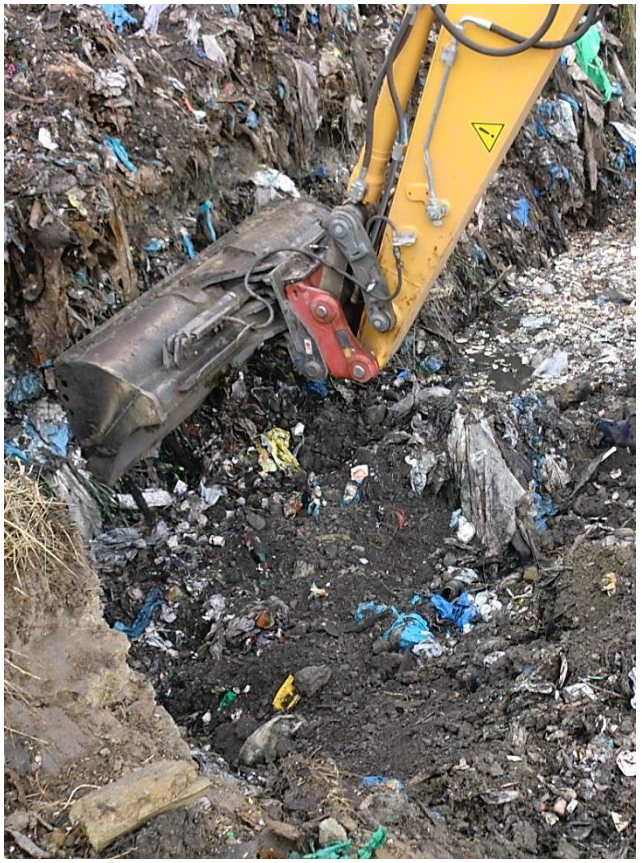
Landfill material excavation



Landfill material excavation

Landfill material excavation

RDF-Production

Mechanical treatment of landfill material

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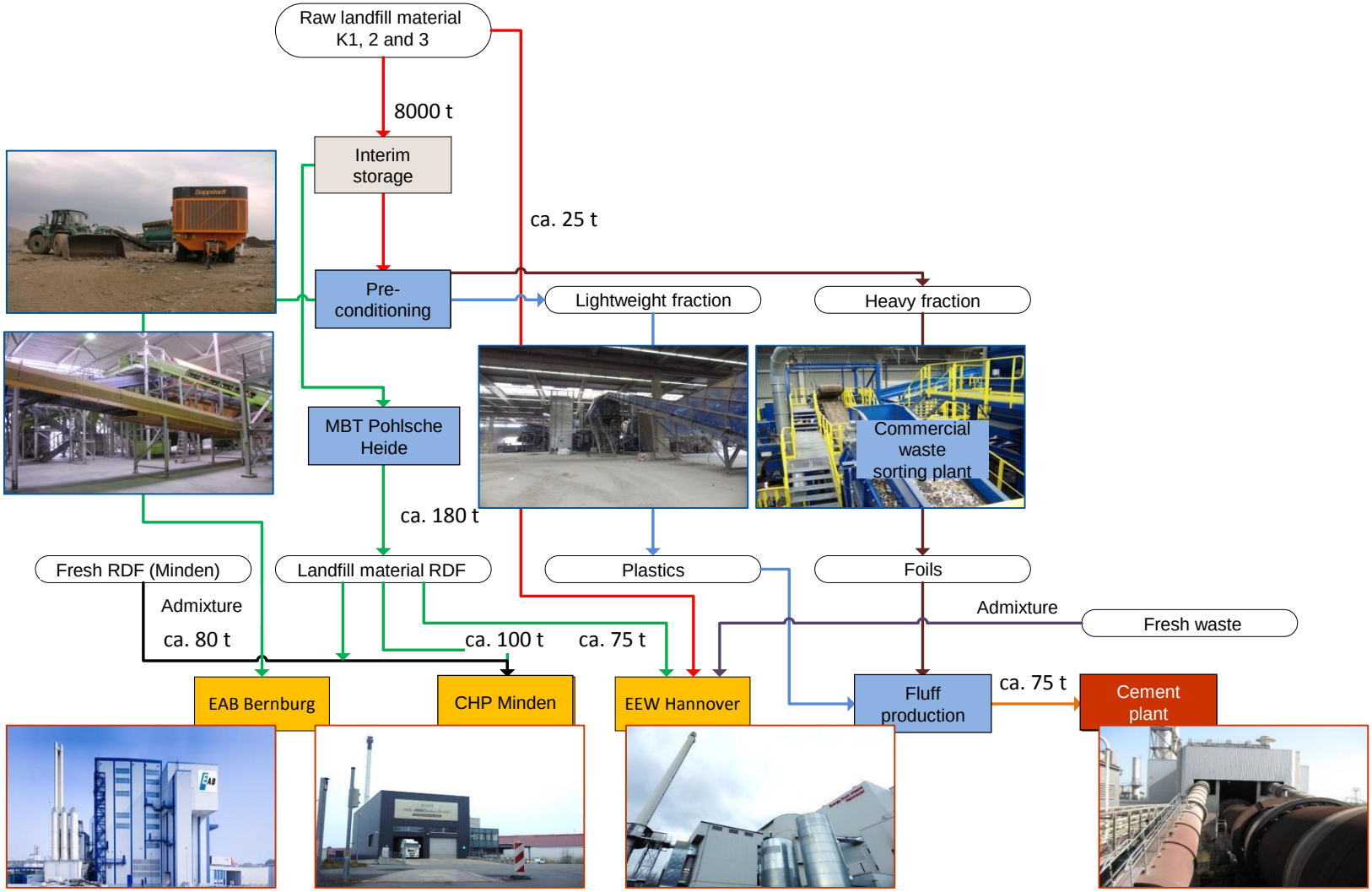
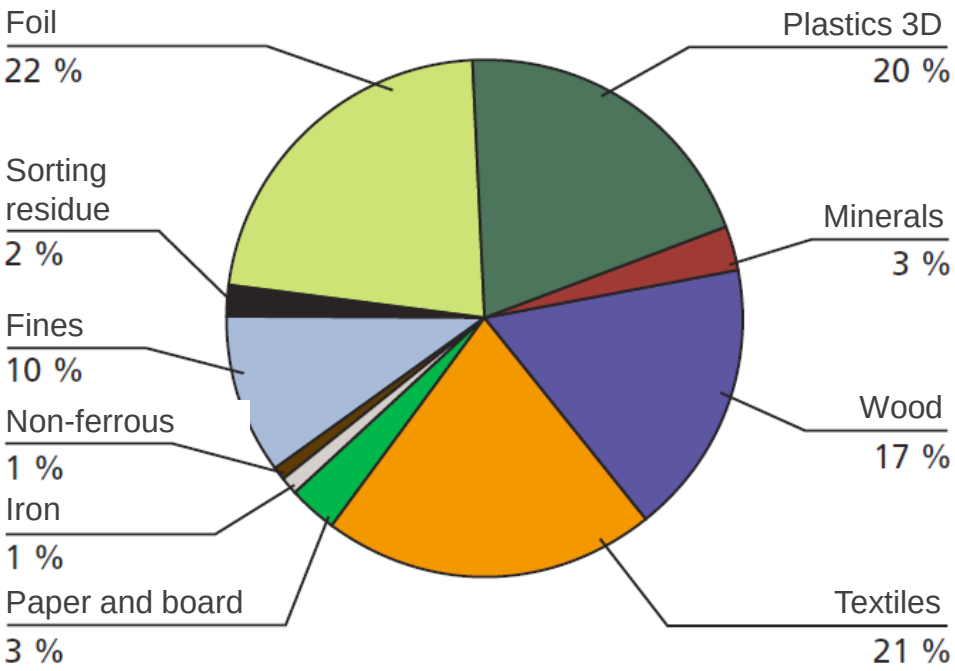
Mechanical & thermal treatment of landfill material – Overview

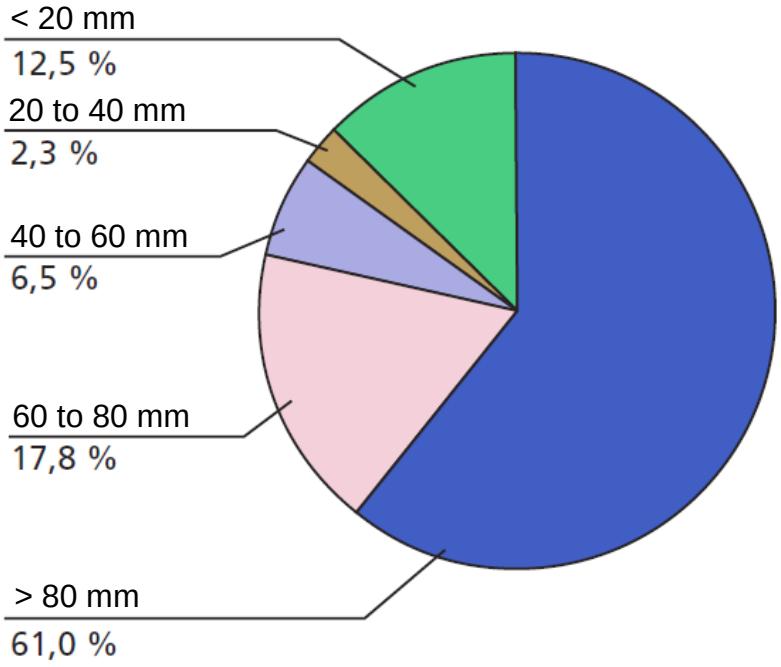


Mechanical treatment of landfill material – Output

RDF material analysis (from mechanical-biological waste treatment plant in Pohlsche Heide)

- Sampling according to LAGA PN 98: Several samples (320 liter)



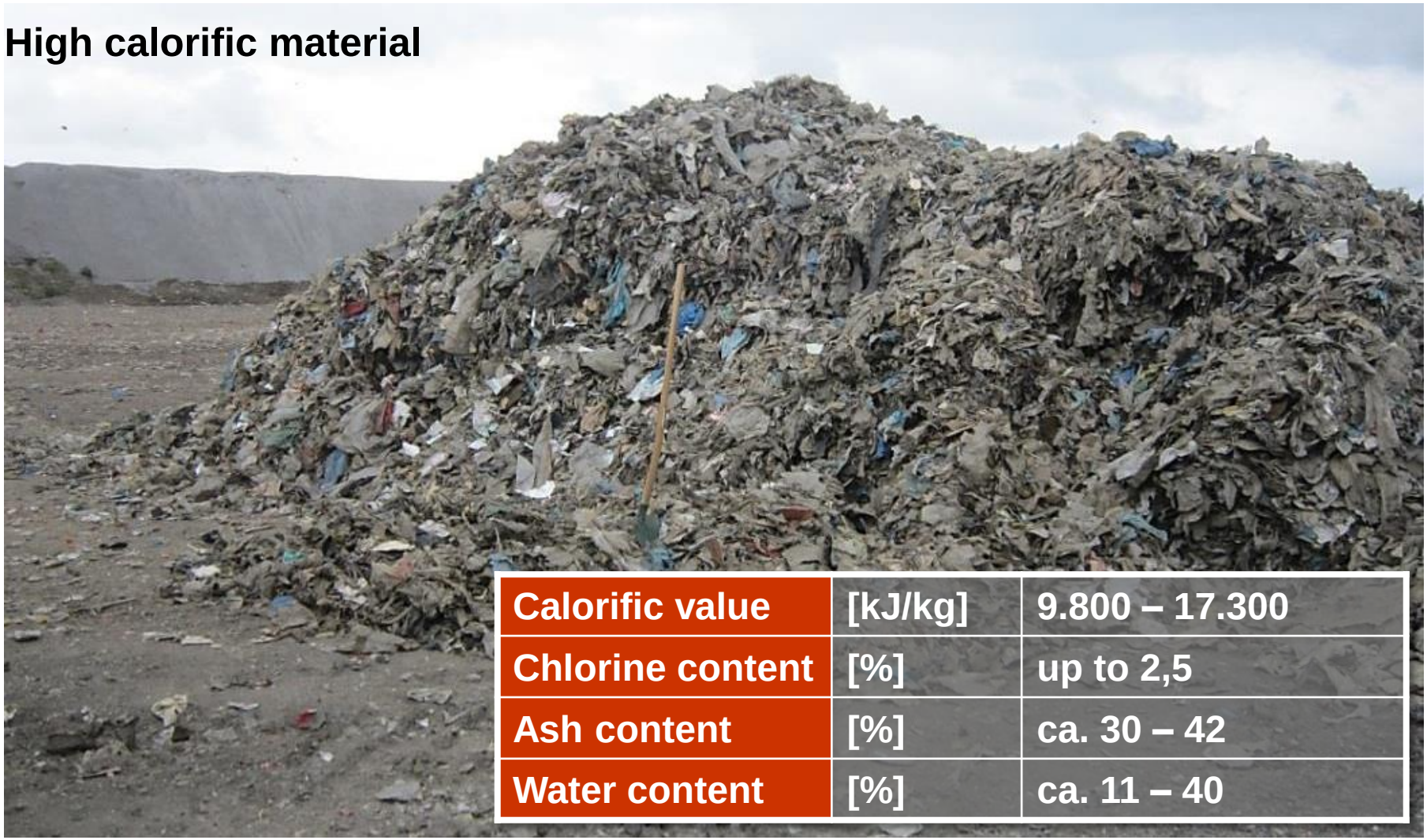


Mechanical treatment of landfill material – Output

Mechanical treatment of landfill material – Output

Mechanical treatment of landfill material – Output

High calorific material



Calorific value	[kJ/kg]	9.800 – 17.300
Chlorine content	[%]	up to 2,5
Ash content	[%]	ca. 30 – 42
Water content	[%]	ca. 11 – 40

Mechanical treatment of landfill material – Output

Mechanical treatment of landfill material – Output

Combustion trials

Waste-to-energy plant EEW Hannover

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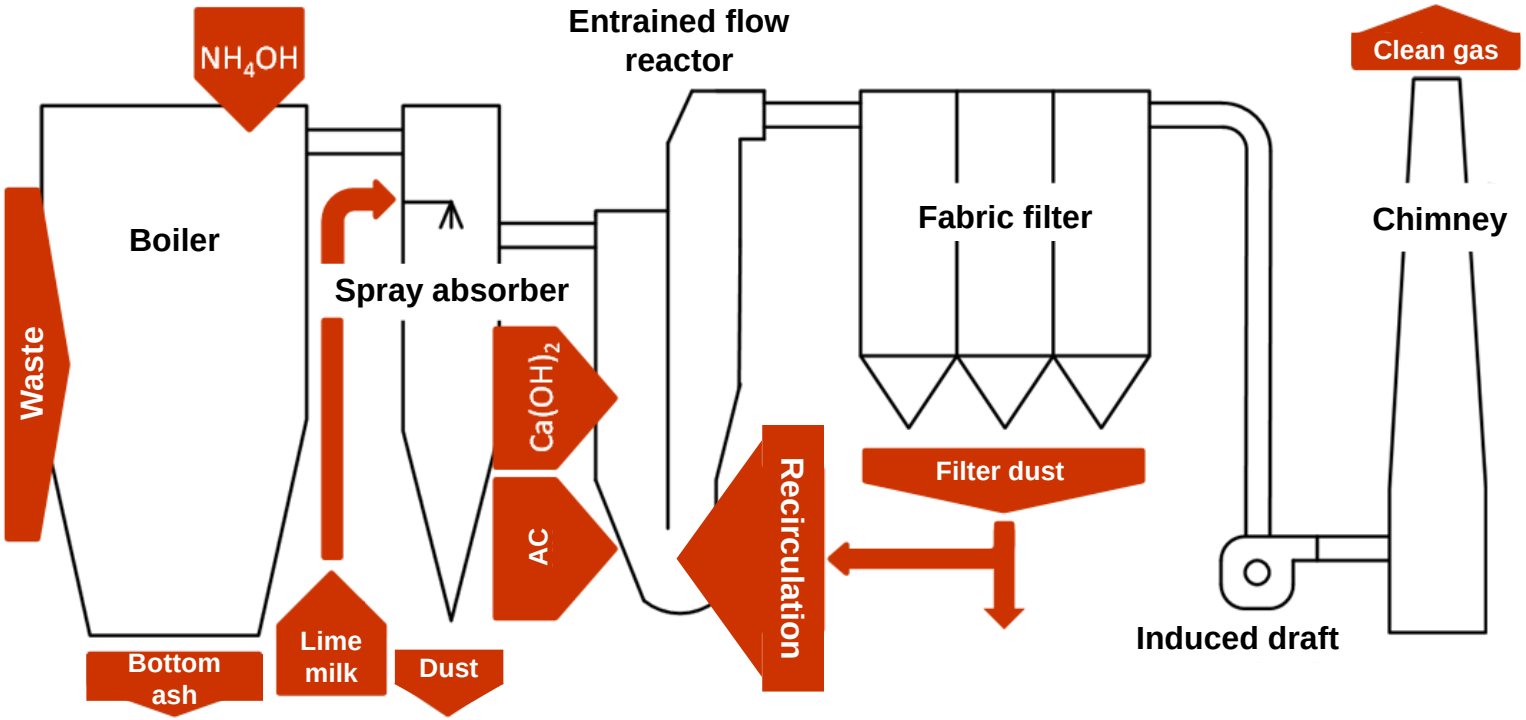
Combustion test EEW Hannover

Plant layout



Combustion test EEW Hannover

Input

- Mono-combustion of landfill material RDF from MBT
- Combustion of crude landfill material in mixture with fresh waste
  - Ratio Landfill material : Fresh waste
    1 : 10, 1 : 5, 1 : 3

Fresh waste	Landfill material RDF	Mixture 1:3
		

Combustion test EEW Hannover

Input

Fresh waste

Landfill material RDF

Combustion test EEW Hannover

Flame image

Fresh waste

Landfill material RDF

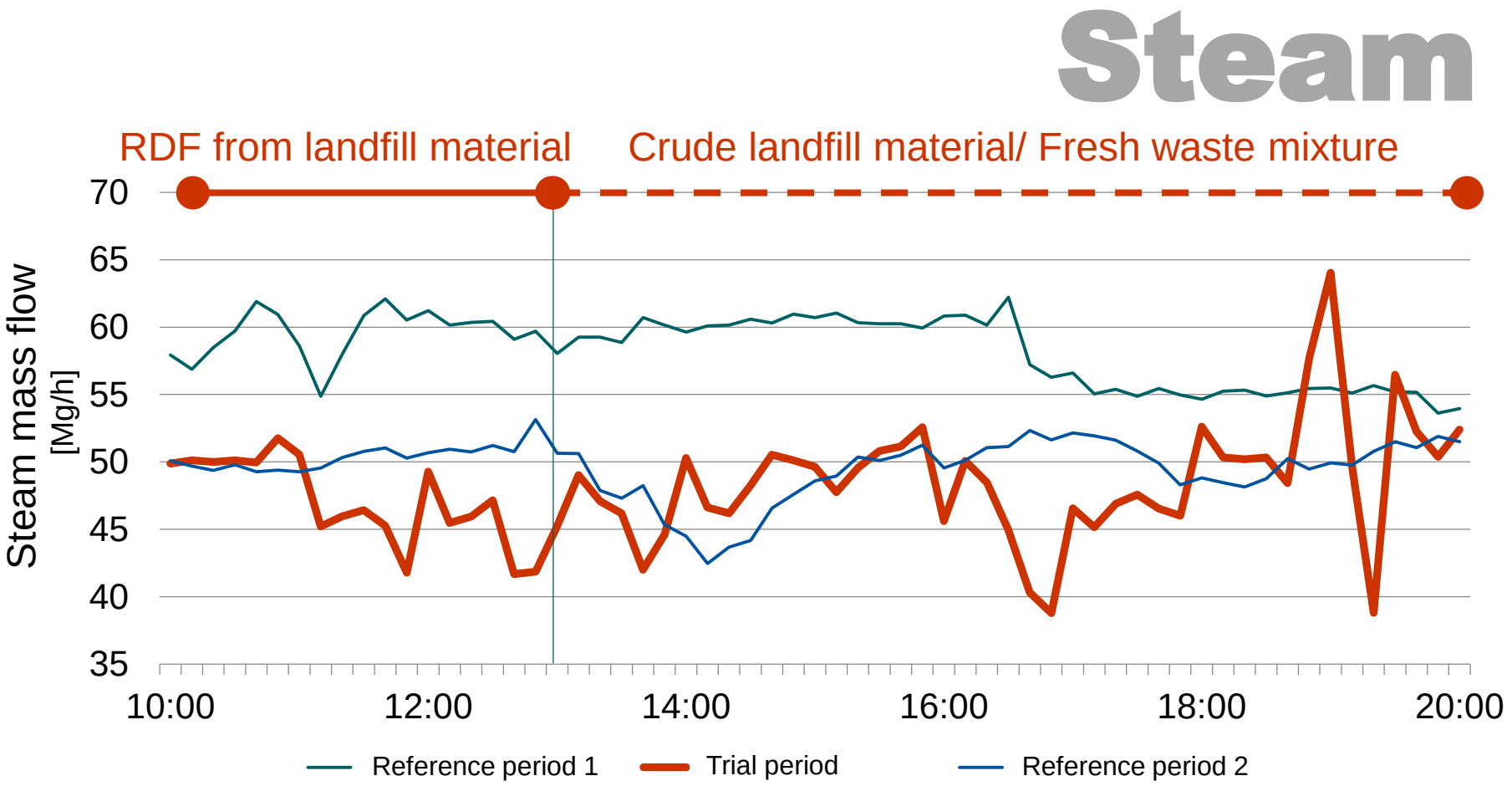
Landfill material – Fresh waste 1 : 3

Combustion test EEW Hannover

Bottom ash

Combustion test EEW Hannover

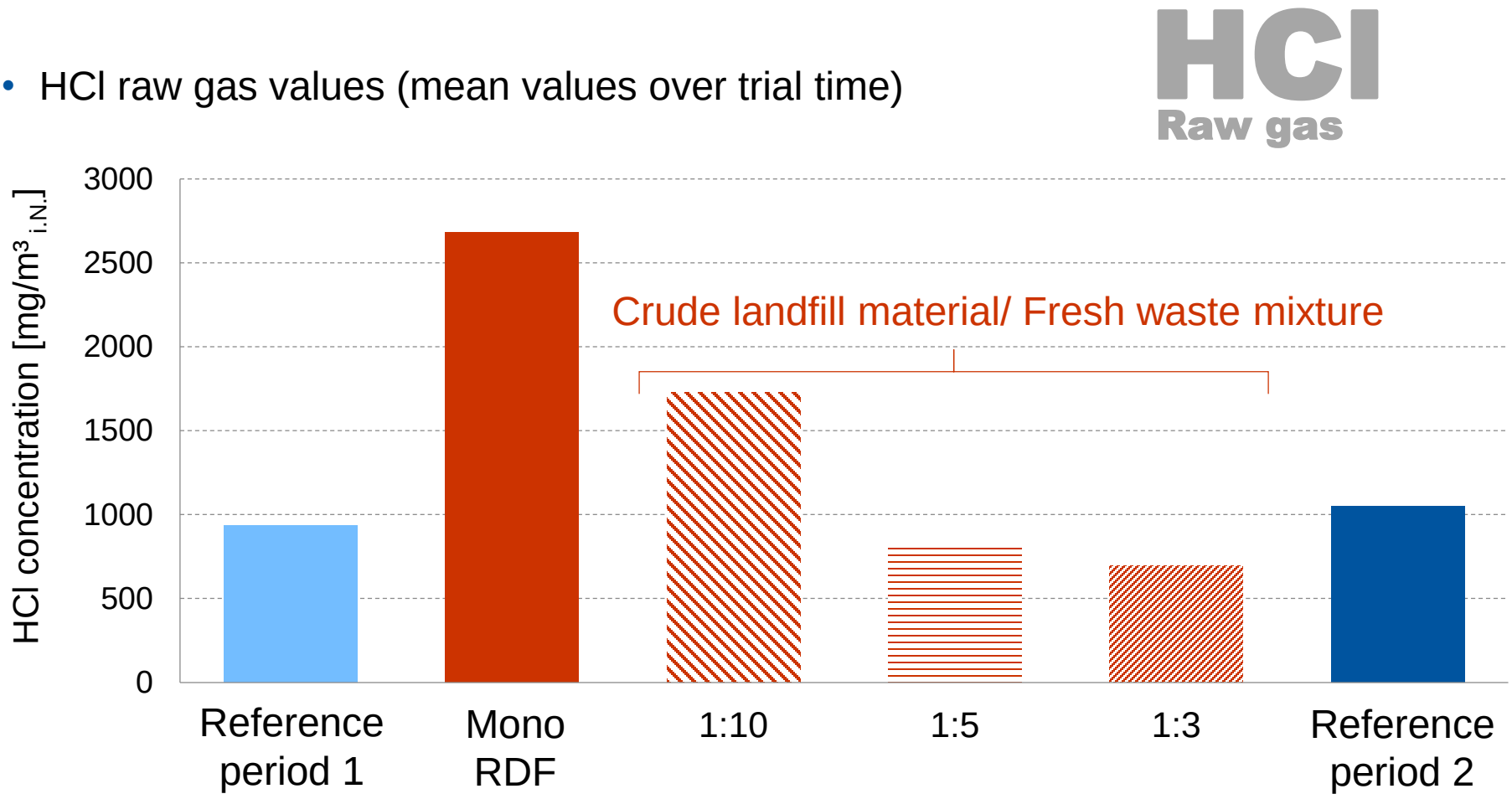
Results



Combustion test EEW Hannover

Results

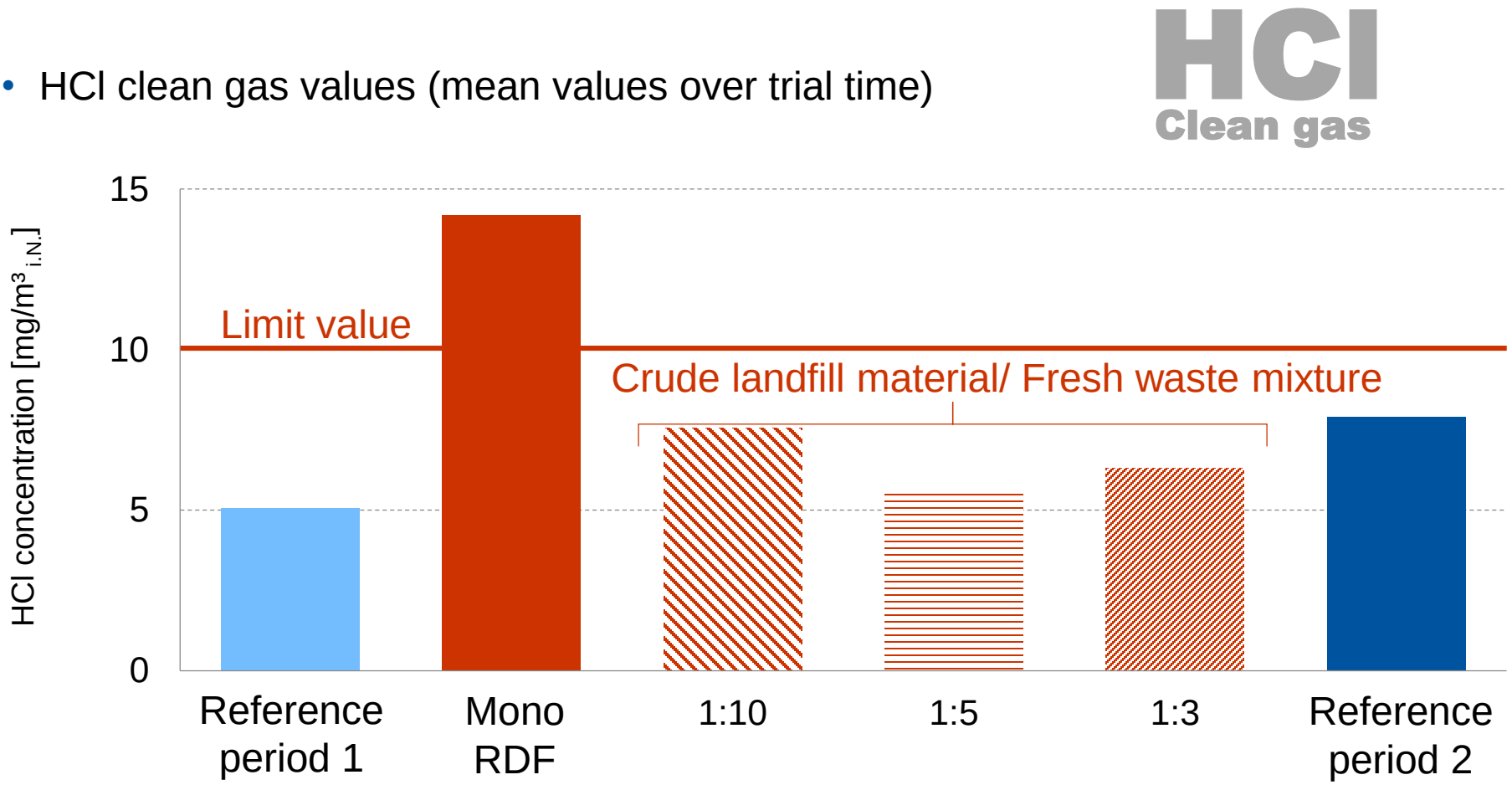
- HCl raw gas values (mean values over trial time)



Combustion test EEW Hannover

Results

- HCl clean gas values (mean values over trial time)

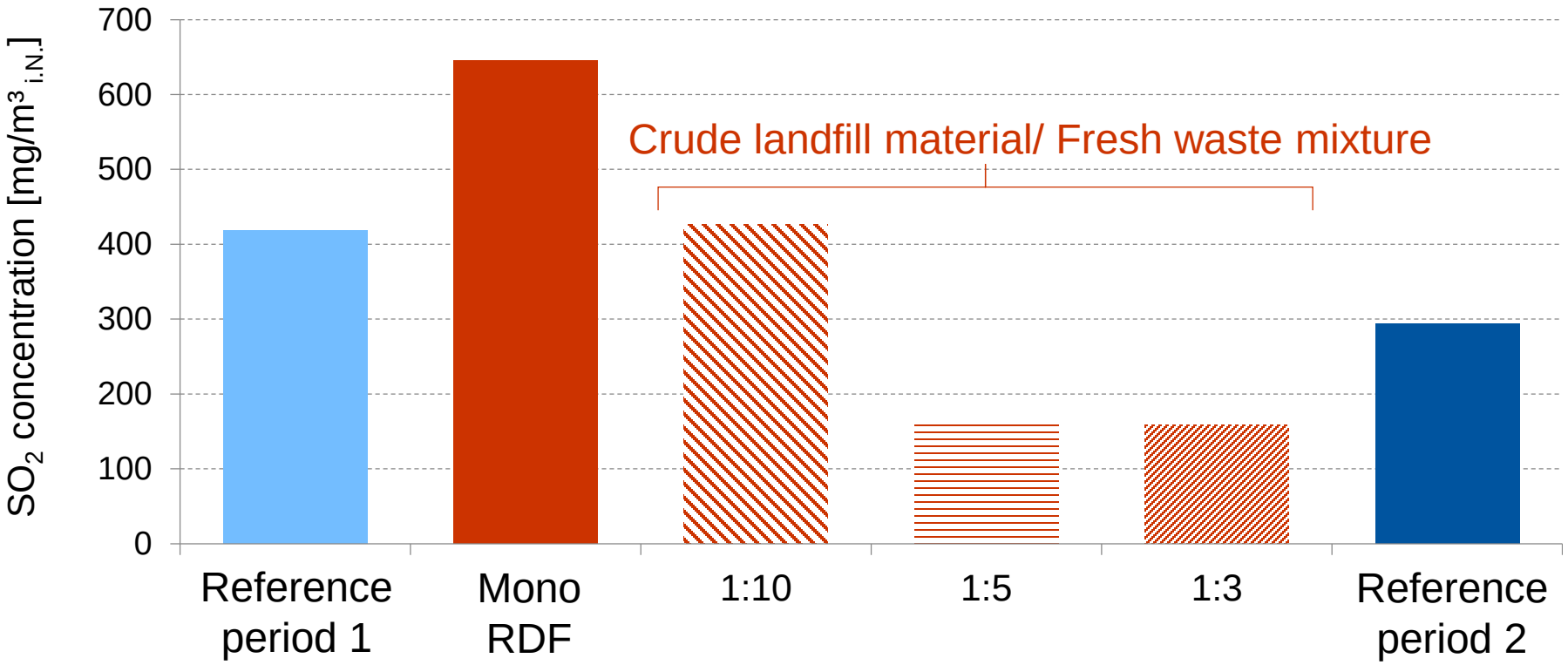


Combustion test EEW Hannover

Results

- SO_2 raw gas values (mean values over trial time)

SO_2
Raw gas

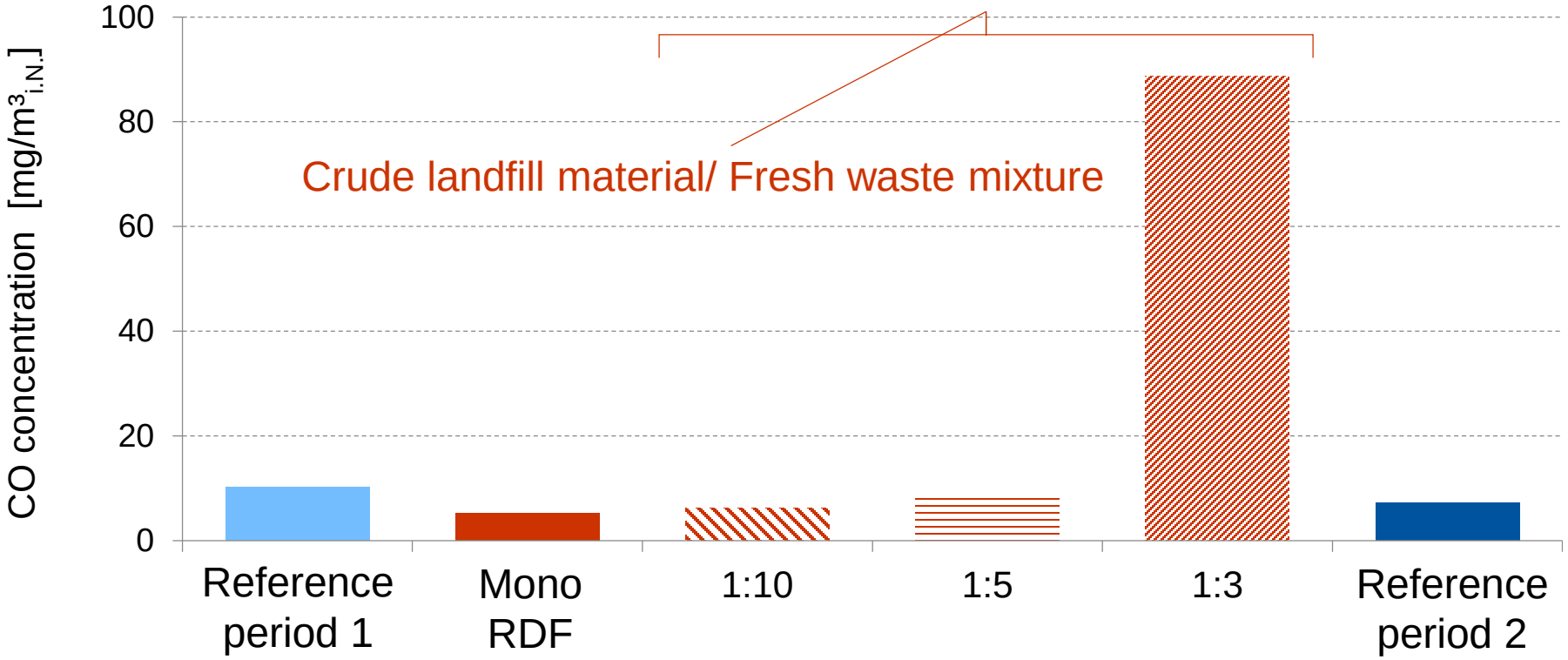


Combustion test EEW Hannover

Results

- CO values (mean values over trial time)

CO

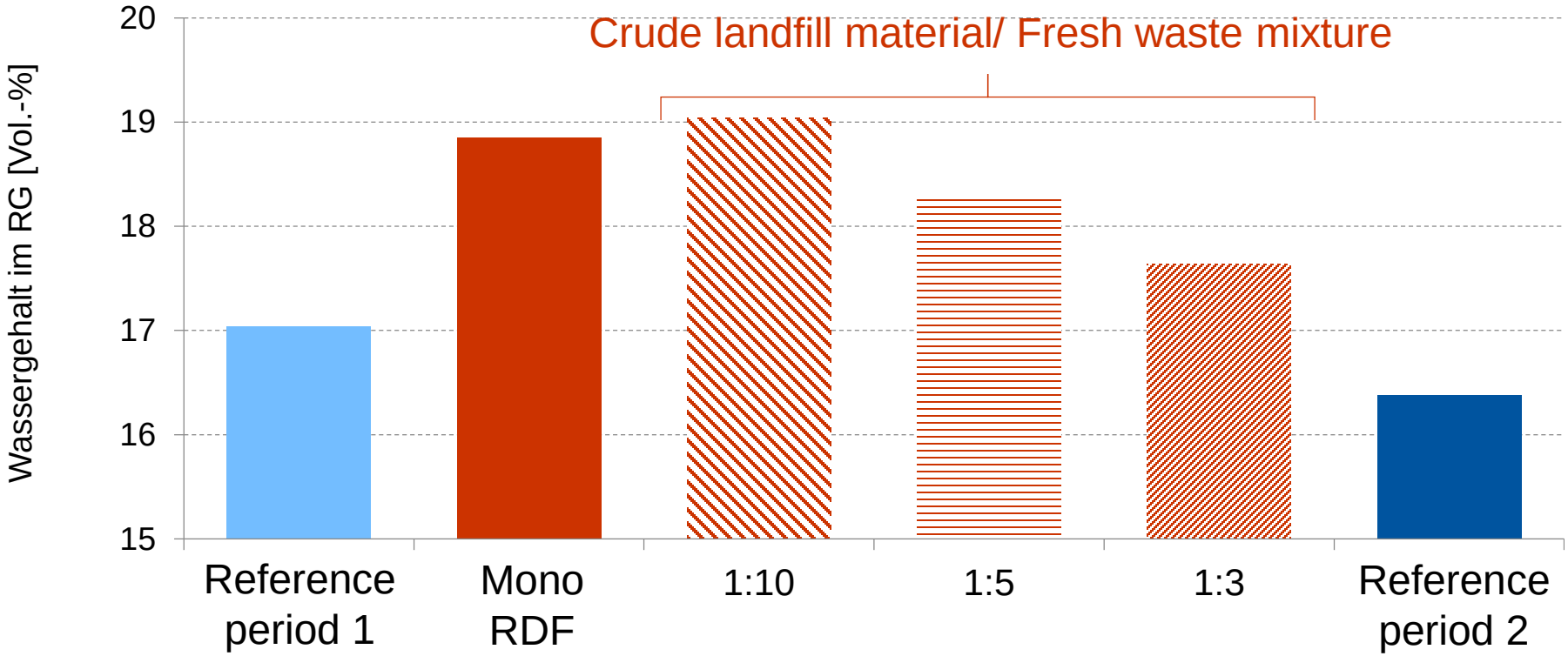


Combustion test EEW Hannover

Results

- Moisture (mean values over trial time)

Moisture



Combustion test EEW Hannover

Results

- RDF monocombustion possible
- Raw gas values of RDF mono-combustion
  - HCl: significant increase by a factor of 2-3 → Exceedance of emission limit
  - SO_2: moderate increase
- Increase of lime milk consumption (ca. factor 2)
- Flue gas moisture noticeably higher
- Target value in steam production not reached because of low calorific value

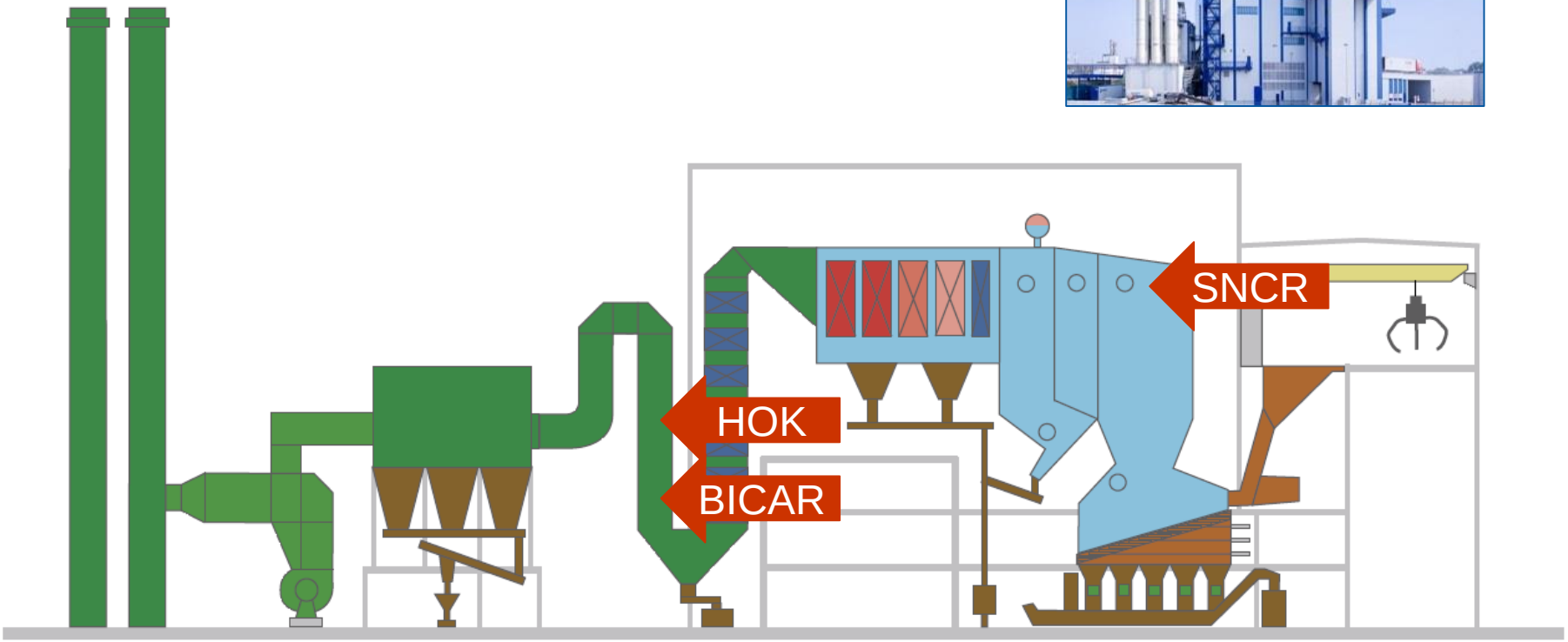
- Crude landfill material only applicable in very high dilution with fresh waste (>1:10)
- Opinion of operator:
  Combustion of landfill material RDF in 1 : 1 mixture with fresh waste
  should be no problem

Combustion trials

Refuse-derived fuel power plant Bernburg

Combustion test EAB Bernburg

Plant layout



Quelle: www.eew-energyfromwaste.com 2014

Combustion test EAB Bernburg

Input

- Mono-combustion of landfill material RDF from preconditioning
  → 1 year storage (drying!) and post-screening (about 50 % mass loss!!!)

Combustion test EAB Bernburg

Input

RDF from fresh waste

RDF from landfill material

Combustion test EAB Bernburg

Input

RDF from fresh waste

RDF from landfill material

Combustion test EAB Bernburg

Flame image

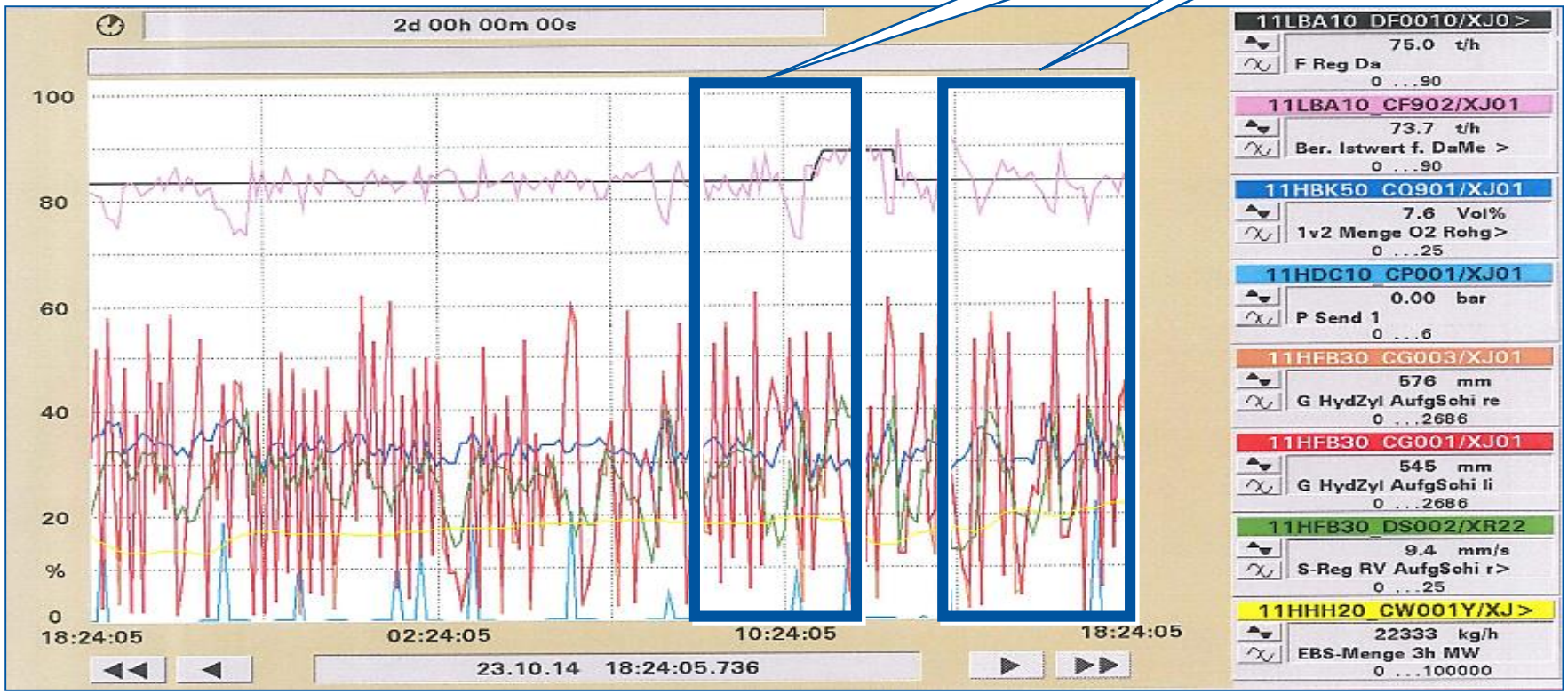
RDF from fresh waste

RDF from landfill material

Combustion test EAB Bernburg

Results

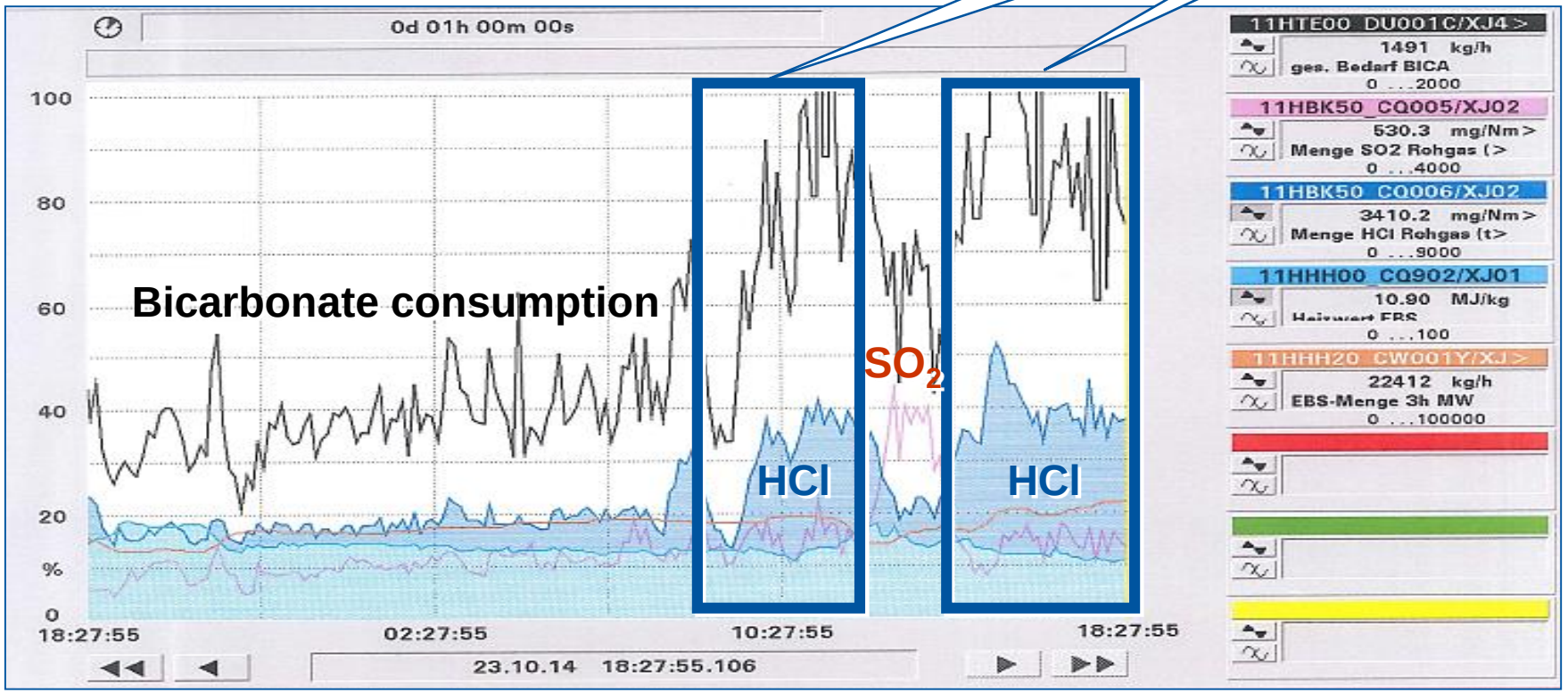
- Steam production



Combustion test EAB Bernburg

Results

- Emissions



Combustion test EAB Bernburg

Results

- Mono-combustion possible: No difference to normal operation
- No problems with material logistics
  Reason: Material was comparatively dry (1 year storage)
- Raw gas values RDF mono-combustion
  - HCl: significant increase by a factor of 2-3 to 2.400 – 4.700 $mg/m^3_{i.N.}$
  - SO_2: unremarkable
- Consumption increase of sodium bicarbonate (ca. factor 2-3)
- Stable steam generation

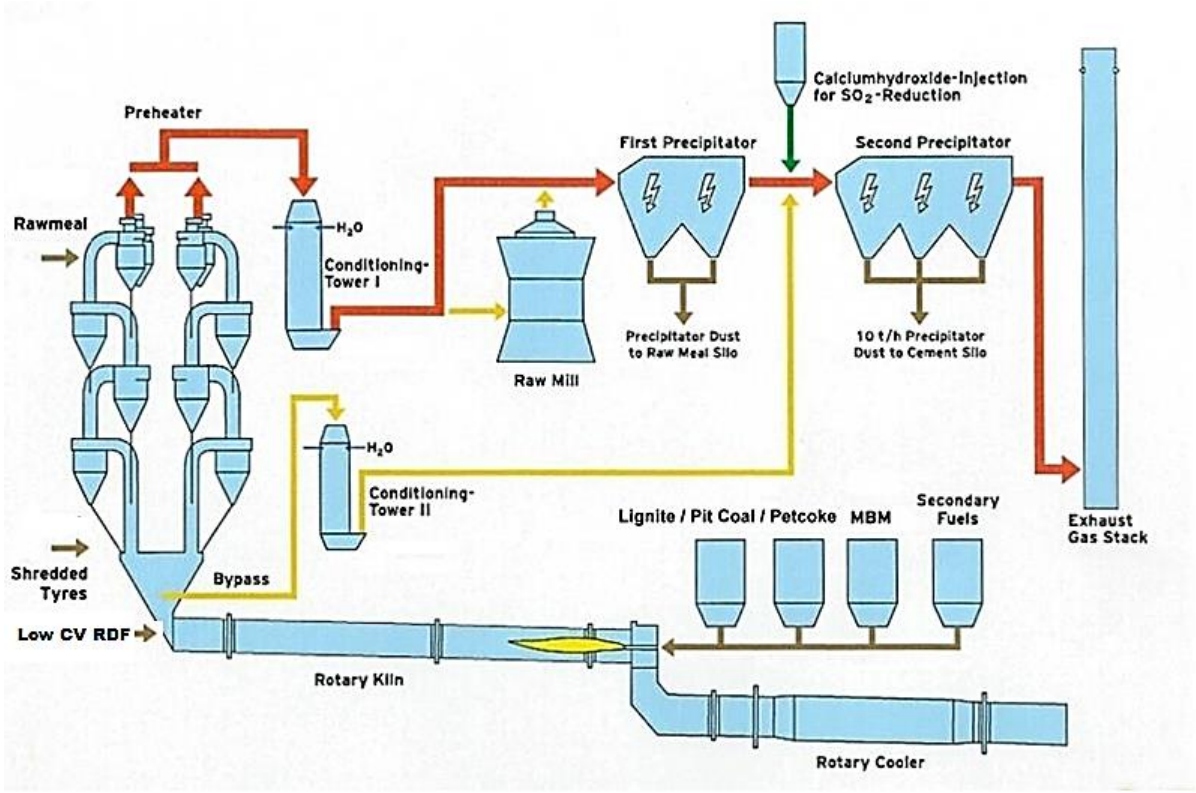
- Operating staff:
  „Combustion behavior of landfill material RDF better than some fresh RDF“

Combustion trials

Cement plant CEMEX Beckum

Combustion test cement plant CEMEX Beckum

Plant layout



Quelle: CEMEX Deutschland 2014

Combustion test cement plant CEMEX Beckum

Input

- High-calorific material with 13 - 15 MJ/kg
- 2 Mg/h (= ca. 5 % of total FWL)

Combustion test cement plant CEMEX Beckum

Input

RDF from fresh waste

RDF from landfill material

Combustion test cement plant CEMEX Beckum

Results

- Troubles in conveying
  - Significant tendency to agglomeration
  - Bridging over screw conveyors
  - Blocking beyond rotary valve

Combustion test cement plant CEMEX Beckum

Combustion test cement plant CEMEX Beckum

Results

- Troubles in conveying
  - Significant tendency to agglomeration
  - Bridging by discharge screw conveyors (isolated)
  - Frequent damer to reduce impact on rotary valve
- Too high chlorine values
  - Values from analysis of CEMEX sampling: Average value: 2,45 %!
  - Too high chlorine content in hot meal
  - Too much chlorine in bypass dust
  - Cl values in clinker (still) okay
- Massive incrustations in preheater tower
  - Higher pressure drop and personnel effort

Combustion test cement plant CEMEX Beckum

Results

- Due to difficult material handling reduction in throughput from 2 to 1,5 Mg/h
- Conveying problems and chlorine concentration led to test termination
- Conclusion
  - Troubles in conveying
  - Chlorine is biggest problem
  - Heavy metal content often above acceptance criterion
  - Drying necessary

→ Complex treatment

- Operator: „Material is not applicable“

Conclusion

Conclusion

Landfill material

- Very heterogeneous with different compositions
  - Much inert material due to soil cover (ash content, fines)
  - High moisture content
  - High content of chlorine (from „0“ to 2,5 %) and sulfur possible
  - Dull and brittle plastic consistency (lack of plasticizer?)
- Untreated landfill material is only applicable in very high mixture
- Treatment to RDF necessary
  - Crushing
  - Fractioning (fine and heavy product separation)
  - Metal separation
  - (Storage for) Drying?
- (Very) low RDF production

Interim conclusion

Thermal treatment

- Incineration in WtE plant possible
- Recommended conditions
  - Treatment with separation of fines and metals
  - Drying (perhaps by storage) appears to be advantageous
  - Incinerator
    - Classical WtE technology with variable grate
    - With great effort (and in mixture) also for simpler systems applicable
  - Increase in raw gas values and consumptions of adsorbents expected
- Combustion of untreated material seems not to be reasonable
  → But what can be done with the separated fines?
- Application in cement plants not possible
- Landfill Mining only for material and energy recovery is unrealistic
  → Economical not feasible

Many thanks to

EEW Energy from Waste GmbH

CEMEX Deutschland AG

Pader Entsorgung GmbH & Co. KG

and Energie Anlage Bernburg GmbH

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and

the authorities granting aid PTJ and BMBF

for the funding.

eew Energy from Waste

CEMEX

PEG

EAB Energie Anlage Bernburg

ptj Projektträger Jülich Forschungszentrum Jülich

Bundesministerium für Bildung und Forschung

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Thank you
for your attention

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