Investigation about Bone Powder as an Alternative Fuel for Circulating Fluidized Bed Combustion

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Animal Waste in Switzerland: From Resource to Waste – Sudden Disposal Crisis

End of year 2000: measures to control BSE

Animal waste
(Fat, Meat, Bones, Horn)

~~**Recycling**~~

Disposal

Switzerland:

Meat powder:	45‘000 t
Bone powder:	**20‘000 t**
Animal fat:	20‘000 t

Fluidized bed incinerator as an alternative

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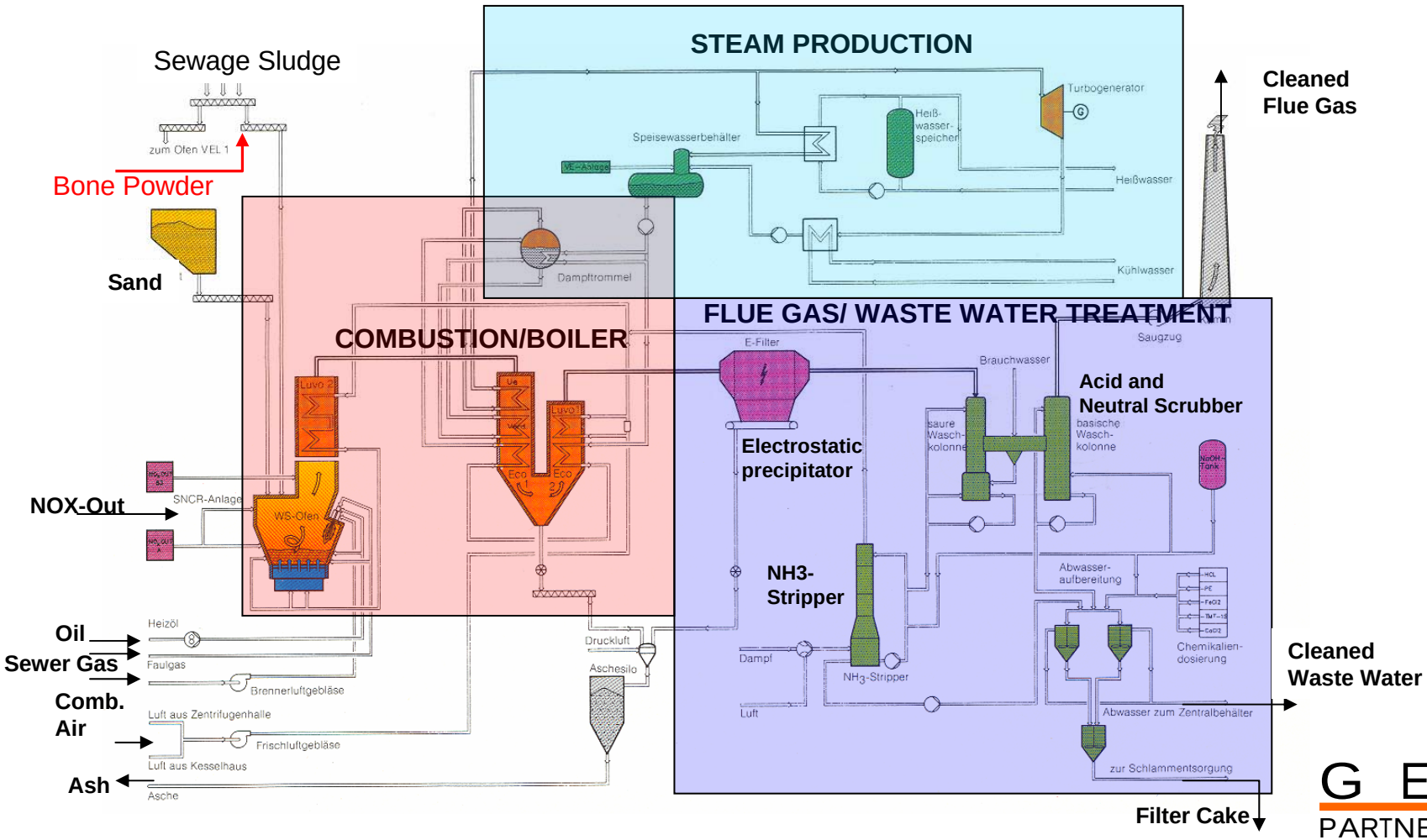
Goal of the Investigation

Proof, that

- **the sludge fluidized bed incinerator HARD in Winterthur, Switzerland is suitable for the co-combustion of bone powder**
- **no increased environmental loads appear due to feed of this additional fuel.**

Sludge fluidized bed incinerator ARA HARD (1)



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Sludge fluidized bed incinerator ARA HARD (2)

Capacity: **3500 kg/h Sewage Sludge (30 w % DS)**

Steam production (Boiler): **2 t/h**

Steam: **33 bar / 355 °C**

Energy production:

- **500 kW hot water (130°C/75°C)**
- **Electricity: 190 kW**

Combustion chamber temperature: **870- 900 °C**

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Bone Powder

Bone Powder is a carbon containing Apatit (Dahllit)

Composition:

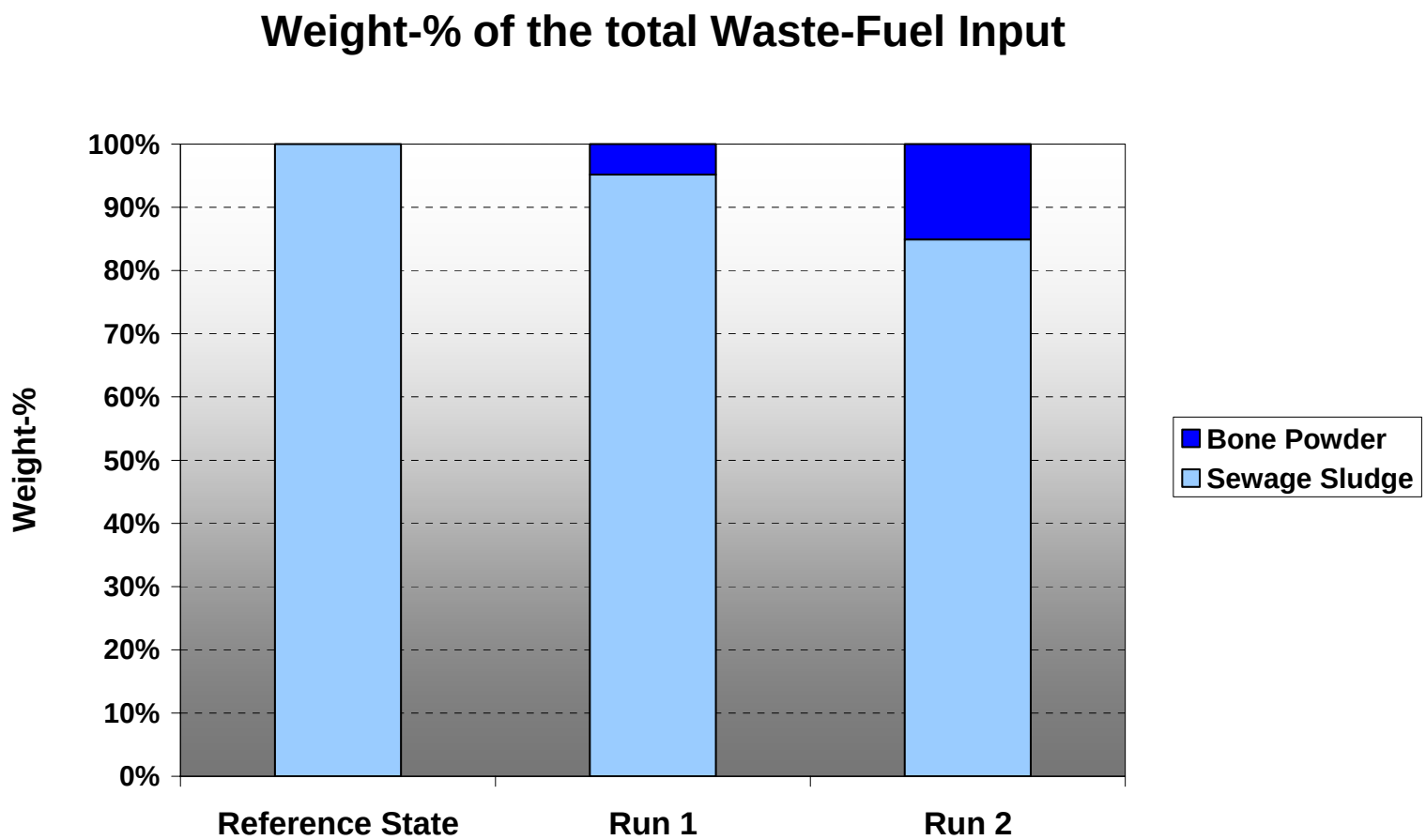
Protein:	**43 %**
Fat:	**6.6%**
Water:	**2.9 %**
Phosphat:	**23.6%**
Carbonate:	**4.3 %**
Chlorine:	**0.2%**
Calcium:	**18.4 %**

Heating value: 11 MJ/kg

Procedure

1) Definition of experiment (test runs)
2) First Test Run (fuel: only sewage sludge) on the 15th of August 2001: Evaluation of the reference state
3) Test Runs with addition of bone powder to sewage sludge
   - run 1 (24th Sept. 01: 5 w-% bone powder)
   - run 2 (25th Sept. 01: 15 w-% bone powder)
   including data collection and sampling procedures
4) Analysis of the samples in the laboratory
5) Data Analysis, Comparision and interpretation of the results

Results (1) Input- Mixture



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Results (2) Changes due to Bone Powder

Increased bone powder addition results in:

- **a lower auxillary fuel consumption (Sewer Gas, Oil)**
- **no siginificant temperature-change in the combustion chamber**
- **no increased flue gas NOX-Emissions**
- **a lower „NOX-OUT“-consumption**
- **a slightly higher combustion air consumption**

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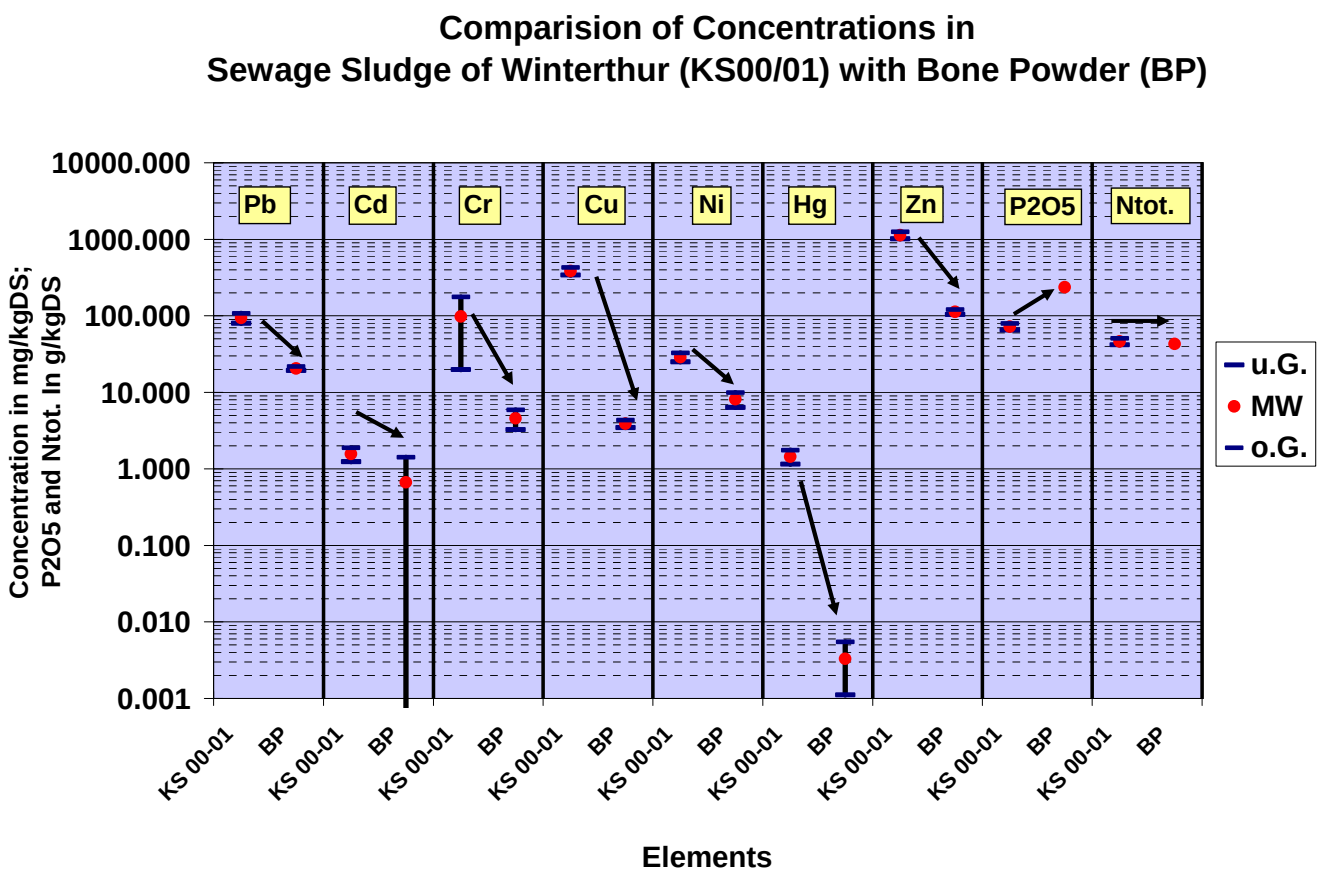
Result (3) Substances in the Input- Fuels



DS: Dry weight

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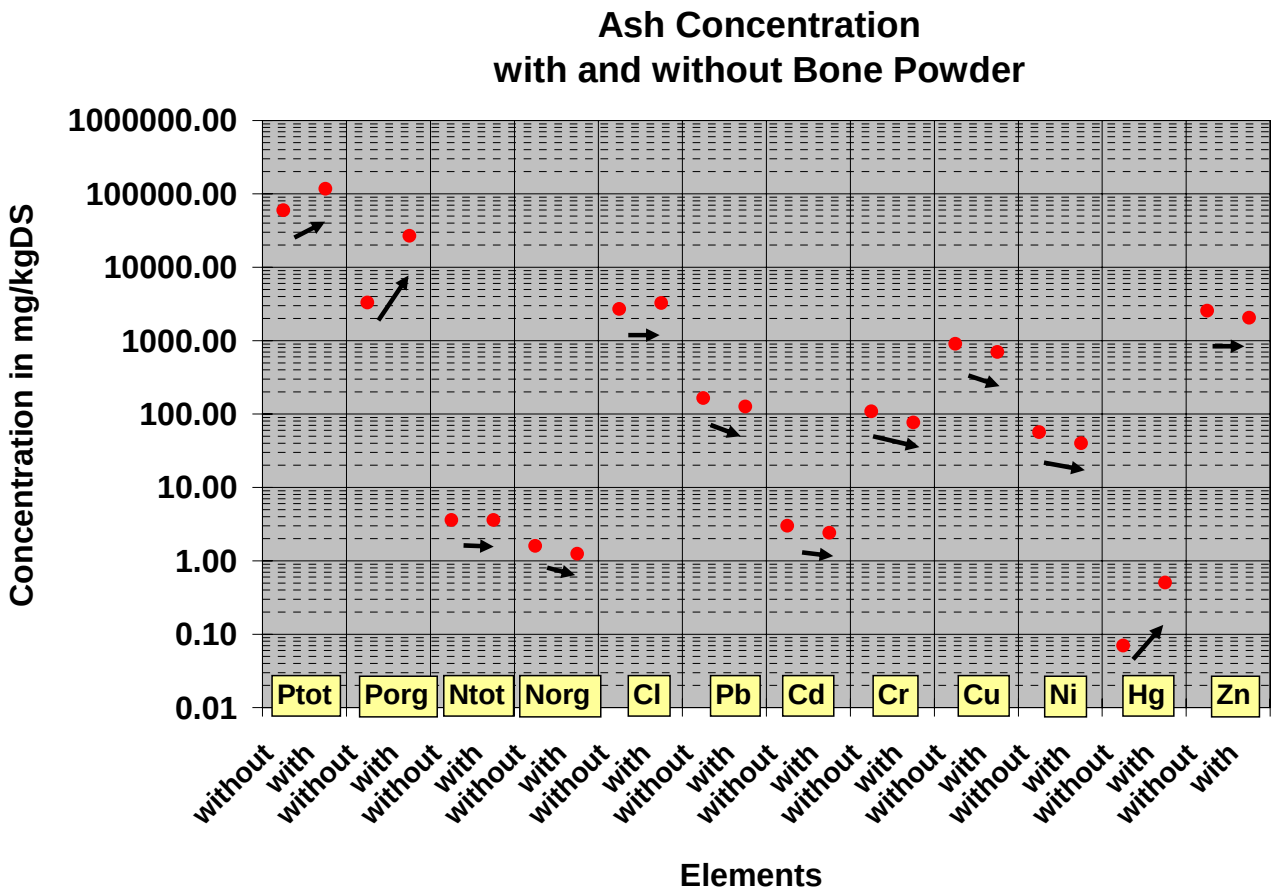
Results (4) Quality of Combustion-by-products Fly-Ash



- Increase of P (total and organic), Cl and Hg
- Decrease of N (organic), Pb, Cd, Cr, Cu, Ni and Zn
- No change for N (total)

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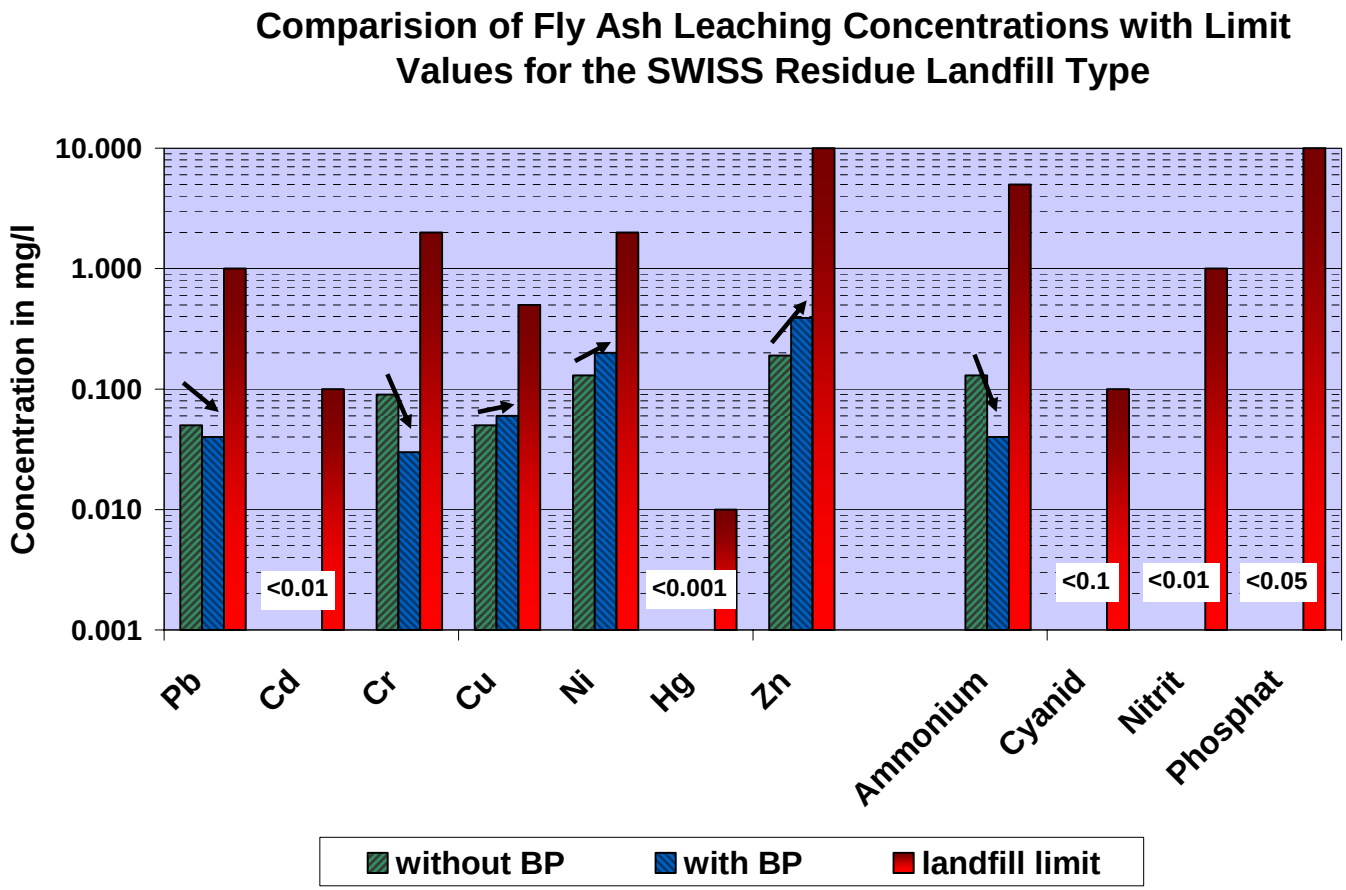
Results (5) Fly ash leaching tests



- No value above Emission Limit
- Increase for Cu, Ni, Zn
- Decrease for Pb, Cr, Ammonium
- other Concentrations are below detection limits

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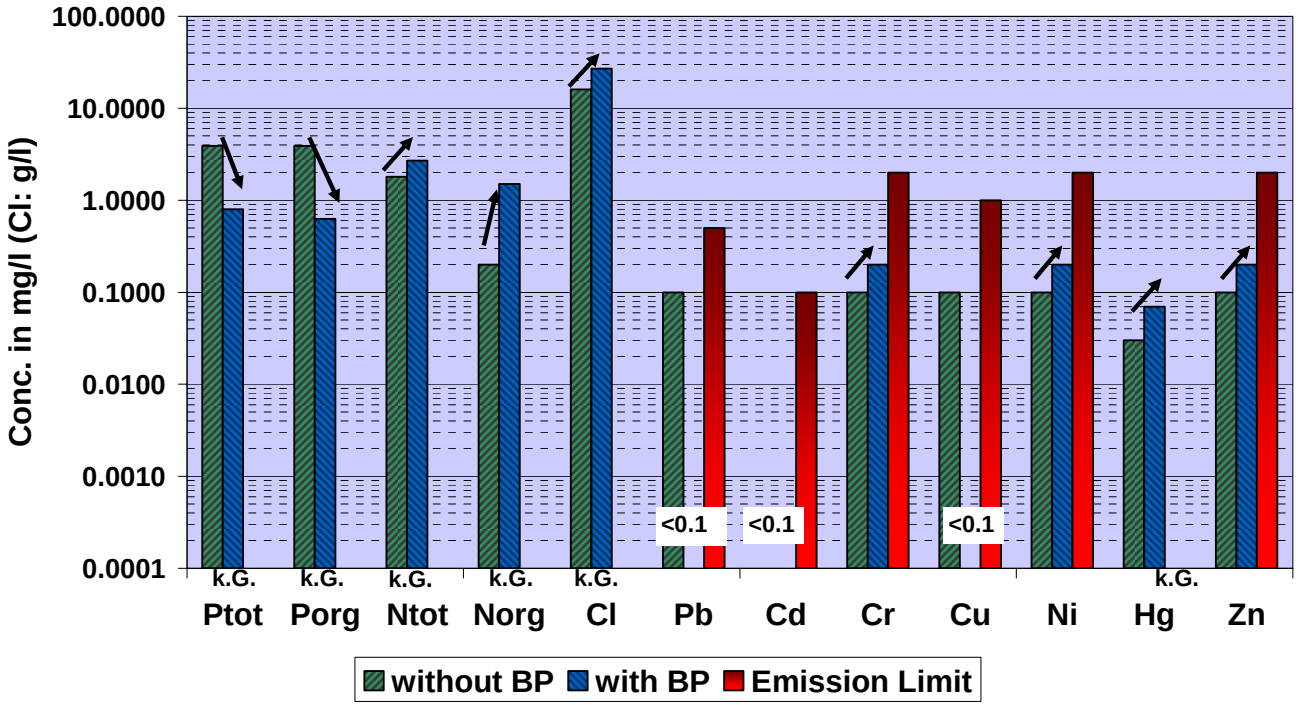
Results (6) Cleaned Waste Water Concentrations

Comparision of Cleaned Waste Water Values with Emission Limits



- **No value above emission limits**
- **Increase for N (organic, total), Cl and some heavy metals**
- **Decrease for P (total, organic) and Pb, Cd, Cu**

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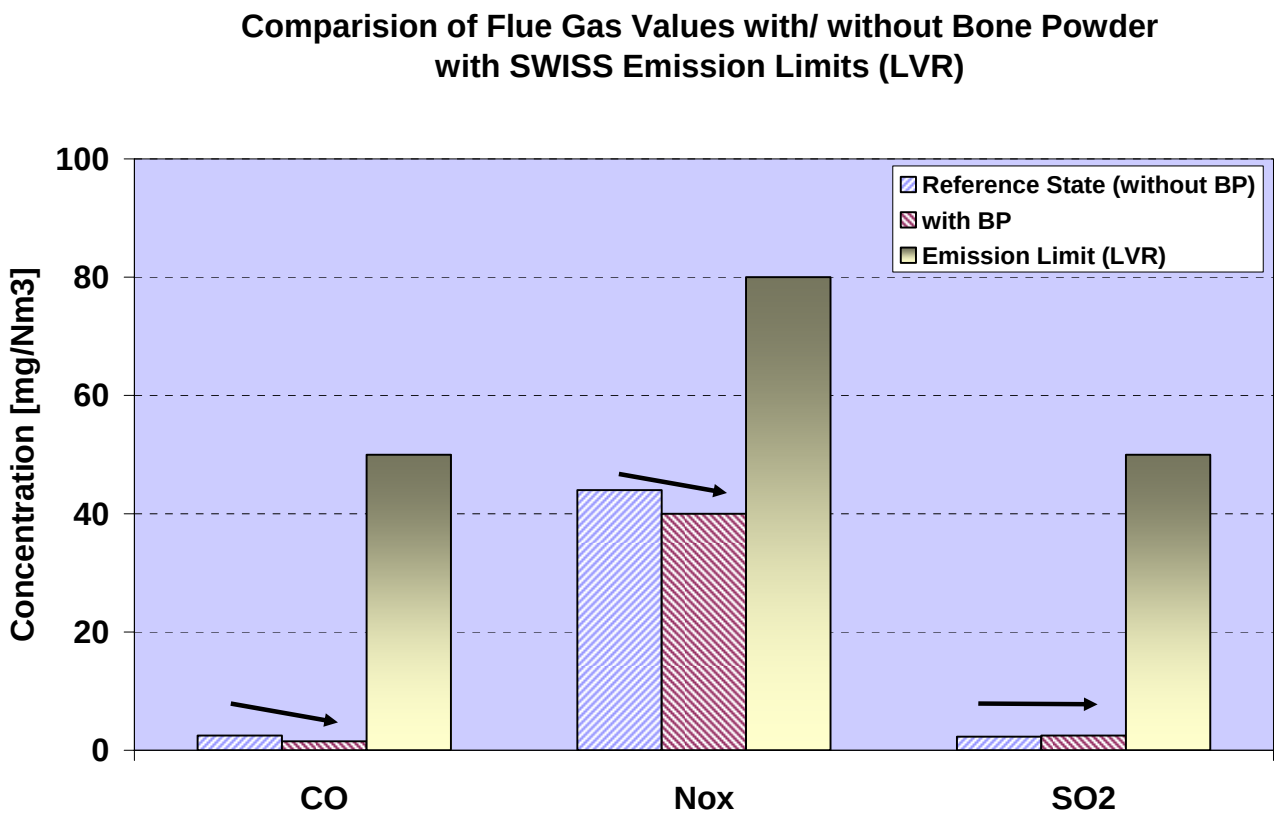
Results (7) Cleaned Flue Gas



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Conclusions

Results demonstrate, that

- **the sludge fluidized bed incinerator HARD in Winterthur, Switzerland is very suitable for the co-combustion of bone powder**
- **no increased environmental loads appear due to feed of this additional fuel.**
- **The addition of bone powder to sewage sludge up to 15 w-% does not have a negative effect on the operation of the incinerator plant**