

Reinhold Environmental Ltd.



2008 APC Round Table
& Expo Presentation

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Nine Years of Operating Experience with Mercury Control in RWE's Coal-Fired Power Plants

Anthony Licata
Vice President

Scott Renninger
Director, Mercury Control
Babcock Power Environmental Inc.



Mercury Control Based on RWE's Activated Lignite HOK Technology

- Technology Developed by RWE Power
- RWE Generates 10,837 MW from Lignite & 16,000 MW from Bituminous
 - 14% of Germany's capacity
- Germany's largest miner of Lignite
 - 100 million tons/year
 - 90 million ton for power generation
 - 10 million tons process and upgraded for sale
- 400 HOK systems operating worldwide



Mercury Control Based on Activated Lignite HOK Technology

- Adsorbent Supply
 - 200,000 Tonnes Production Capacity
- Complete Injection Systems
 - Design and Supply
 - Integrated Systems
 - Air Pollution Control Technologies – FGD –NO_x - SO₃
– Dioxins - PM
- Technical Services
 - Integrated Systems Approach
 - Consulting Services
 - Startup and Commissioning



RWE Application on Coal Fired Plants

- Plants produce steam to dry lignite coal
 - Fluid bed boilers
 - ESPs
 - Limestone added for acid gas control
- Plants burn raw lignite and sewage sludge
 - Burning sludge requires mercury control



Operating Plants

- Wachtberg
 - 2 CFB combustion systems with reheat
 - 2,600 psi/977 °F steam
 - 385,000 lb/h steam
- Berrenrath
 - 2 CFB combustion systems without reheat
 - 1,305psi/932 °F steam
 - 617,000 lb/h steam



Berrenrath

Wachtberg

Type of HOK

Pulverized 63 mm

Pulverized 63 mm

Dose range

88 – 265 lb/hr

66 – 330 lb/hr

Operating rate

88 lb/hr

88 lb/hr

Flue Gas

H₂O

30%

30%

SO₂

35 – 52 ppm

70 – 87 ppm

HCl

12 – 24 ppm

< 12 ppm

O₂

4 – 5%

5 – 6%

Temperature

320

338

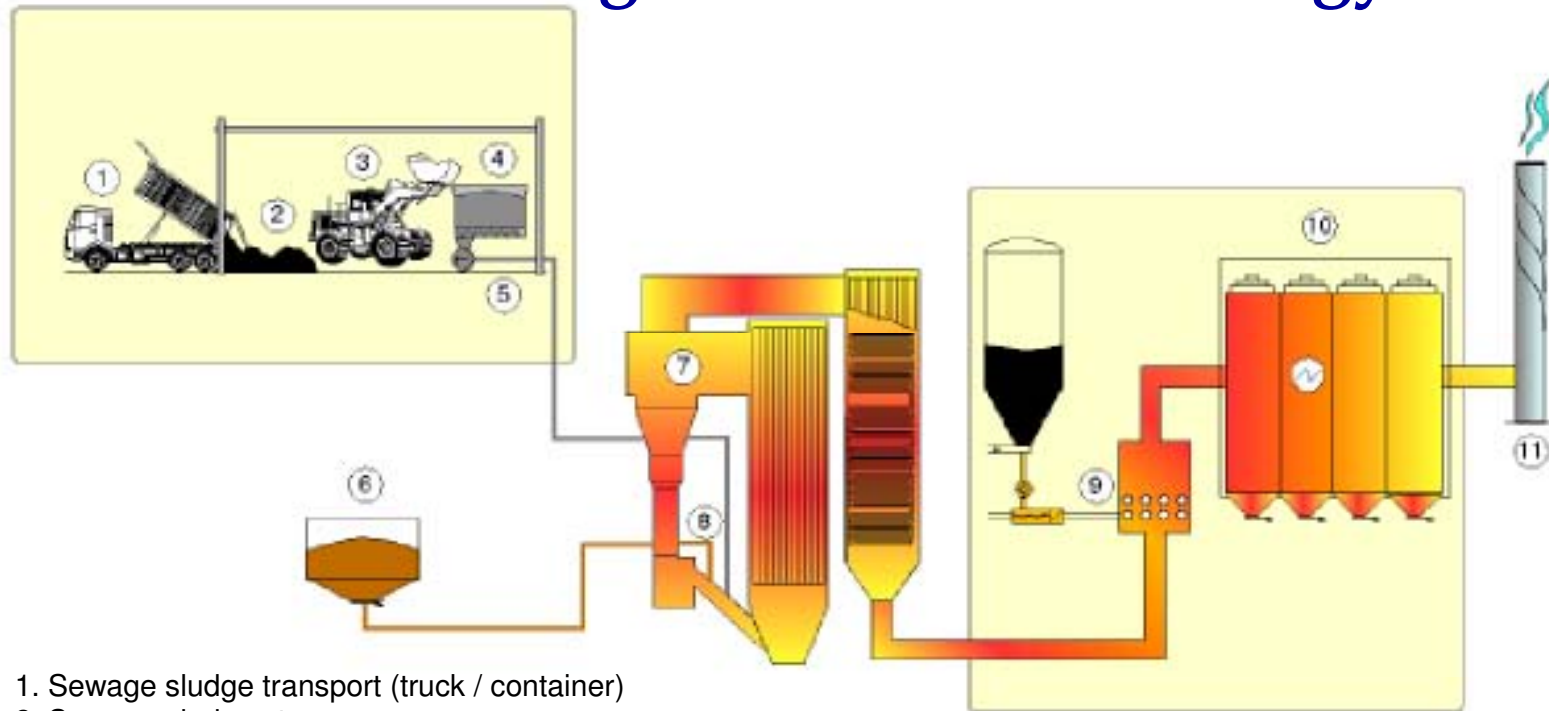


Lignite Analysis

HHV	4500 Btu/lb
H ₂ O	52%
S	0.2 – 0.5%
Cl	365 – 600 mg/kg
Ash	18% (dry)



Mercury Control Based On Activated Lignite HOK Technology

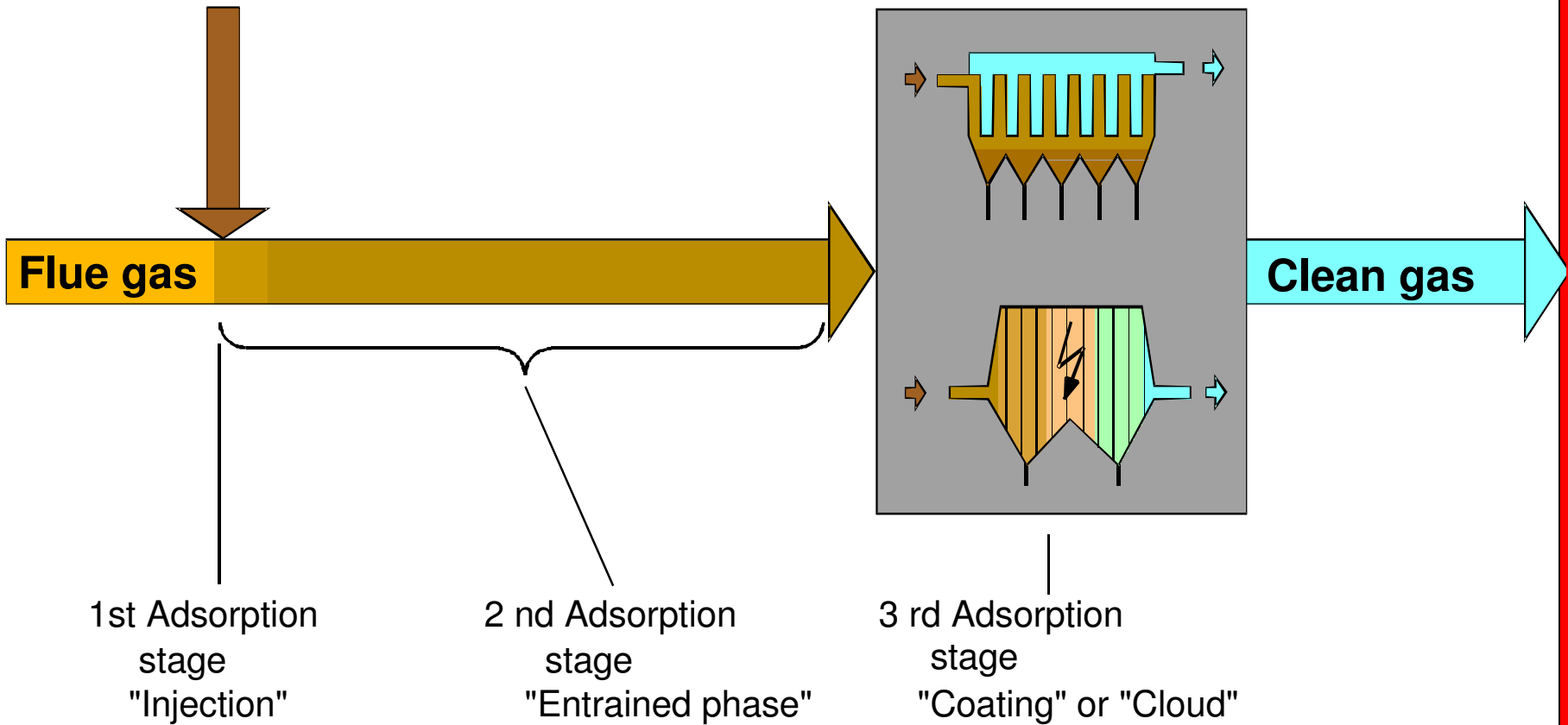


1. Sewage sludge transport (truck / container)
2. Sewage sludge storage
3. Wheel loader
4. Feeding hopper / discharging system with screw
5. Solids pump
6. Raw lignite bunker
7. Circulating fluidized-bed firing system
8. Dosing - fuel feeding system
9. Heavy metal separating system with activated lignite
10. Electrostatic precipitator
11. Stack



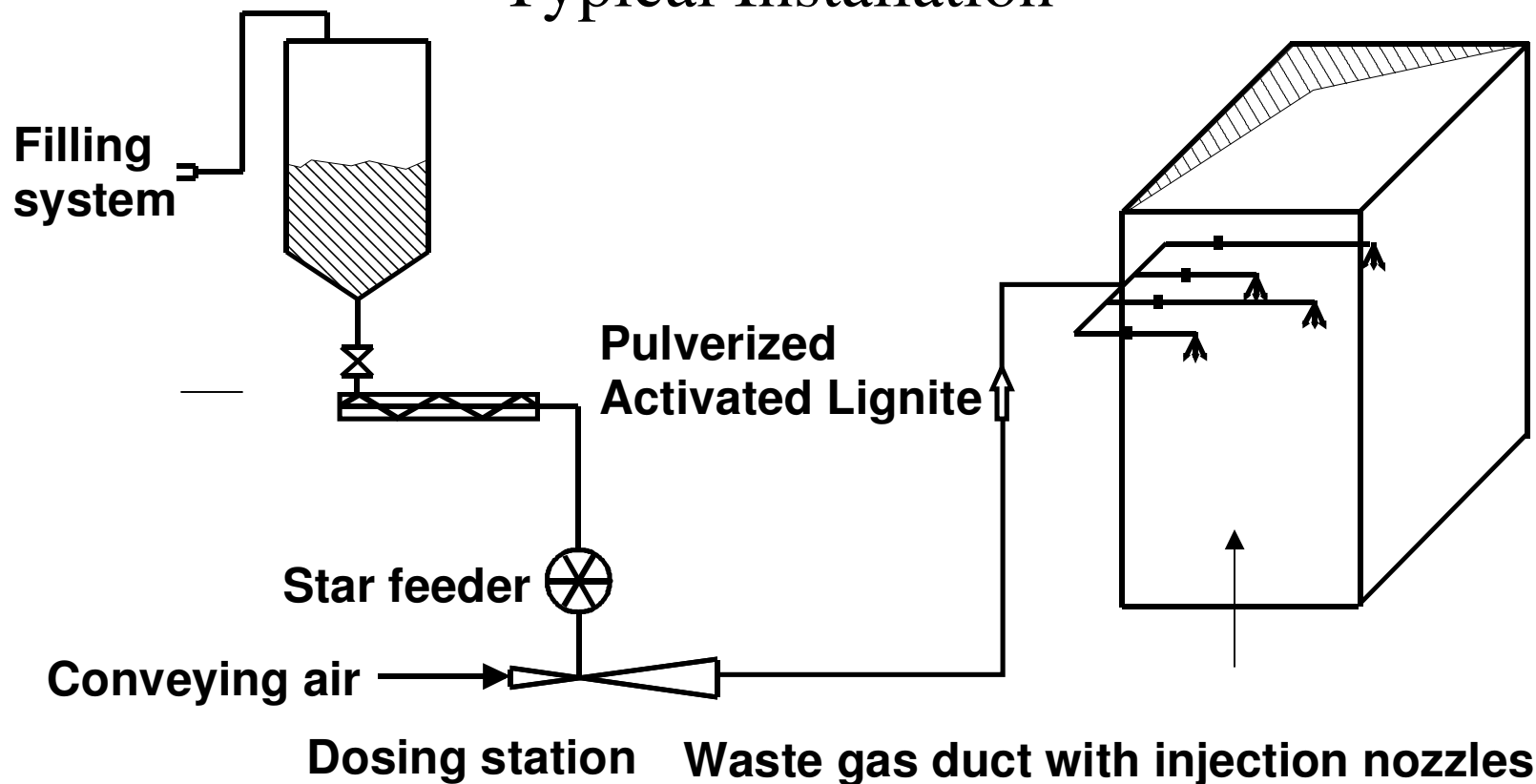
Pulverized activated lignite

Ash separator





Typical Installation



Activated Lignite Dosing System



HOK Analysis

Proximate analysis	Moisture content	0.5 % wt
	Ash content	9 % wt
	Calorific value	29.9 MJ/kg
	Volatiles	3 % wt
Ultimate analysis	Carbon (C-H-N-O)	88.5 % wt
	Sulfur	0.5 % wt
Ash analysis	CaO	41 % wt
	MgO	14 % wt

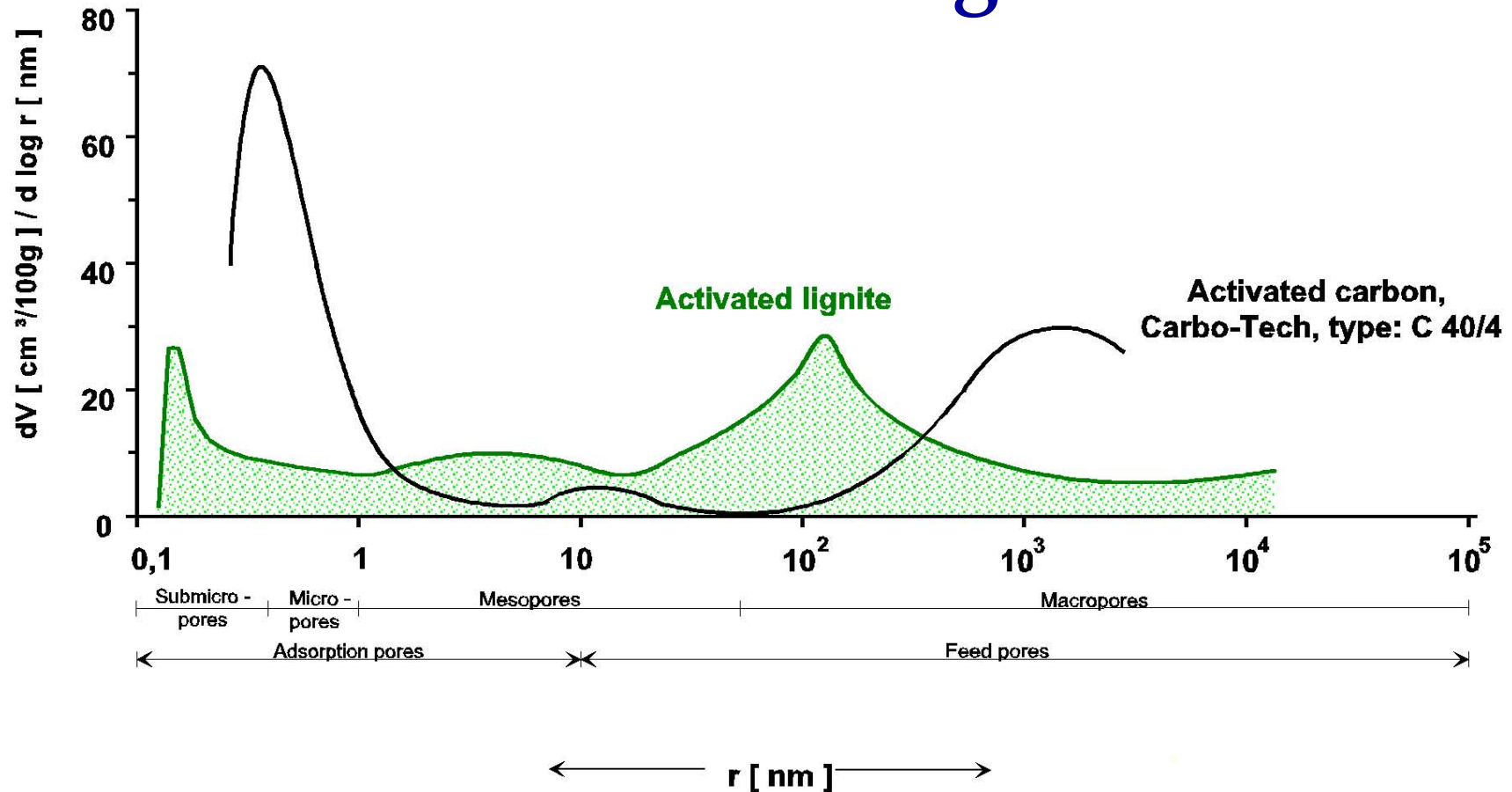


HOK Parameters

Physical parameters	HOK pulverized	HOK super
Grain size [mm] d ₅₀	< 0.63	< 0.24
Bulk density [t/m ³]	0.55	0.55
Specific surface area	300 m ² /g	300 m ² /g



HOK Design





Mercury Control Based on Activated Lignite HOK Technology

- Technology Experience
 - o Coal-fired Power Plants
 - o Waste-to-Energy Plants
 - o Sewage Sludge Disposal Plants
 - o Co-burning Facilities
- US Coal-Fired Test Projects
 - o Brayton Point
 - o Plants Yates & Gaston
- Operating Plants
 - o Berrenrath
 - **275 MWth (76 MW) – 1999**
 - o Wachtberg
 - **166 MWth (56MW) - 2003**





Mercury Control Based On Activated Lignite HOK Technology

- Operating Plants
 - Circulating Fluidized Bed Boilers
 - ESP PM Control
 - Fuel Lignite + Sewage Sludge

- o Berrenrath
 - **Dose Rate 6.3 lb/MMACFM**
 - **+ 85% Hg removal**

- o Wachtberg
 - **Dose Rate 8.9 lb/MMACFM**
 - **+ 85% Hg removal**







RWE Design Tools



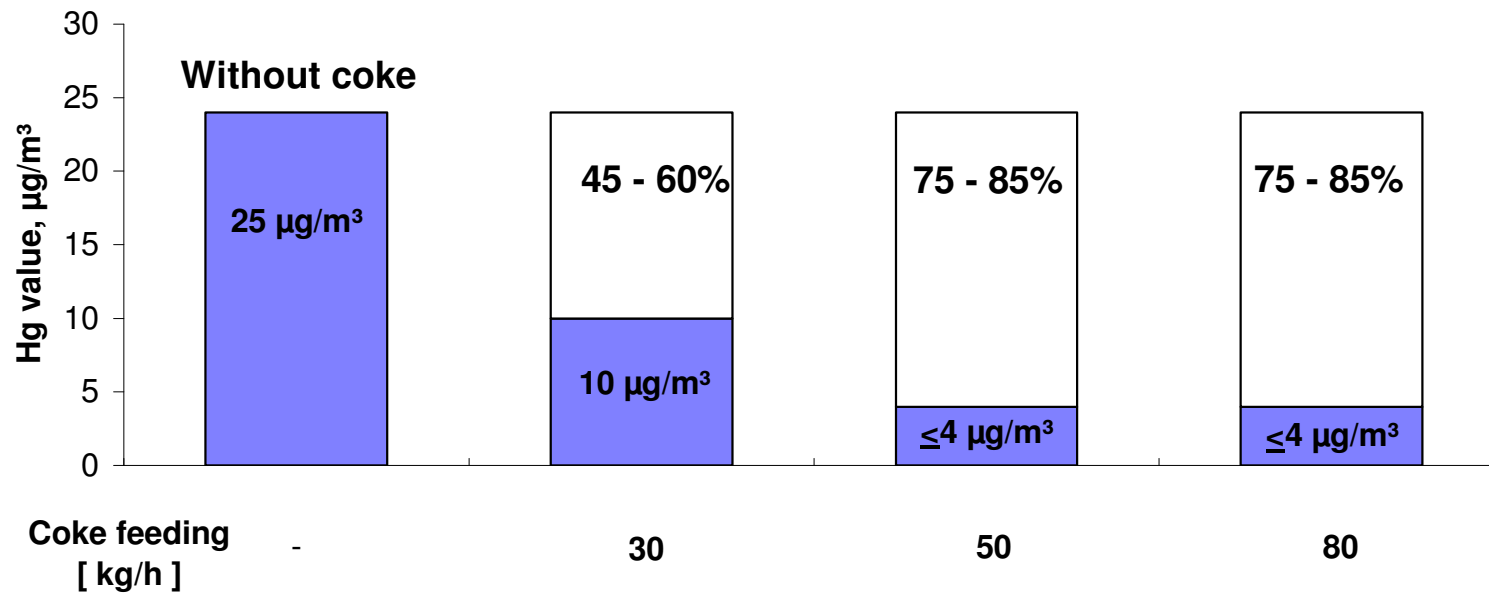


RWE Design Tools





Berrenrath HOK Dose Rate Test



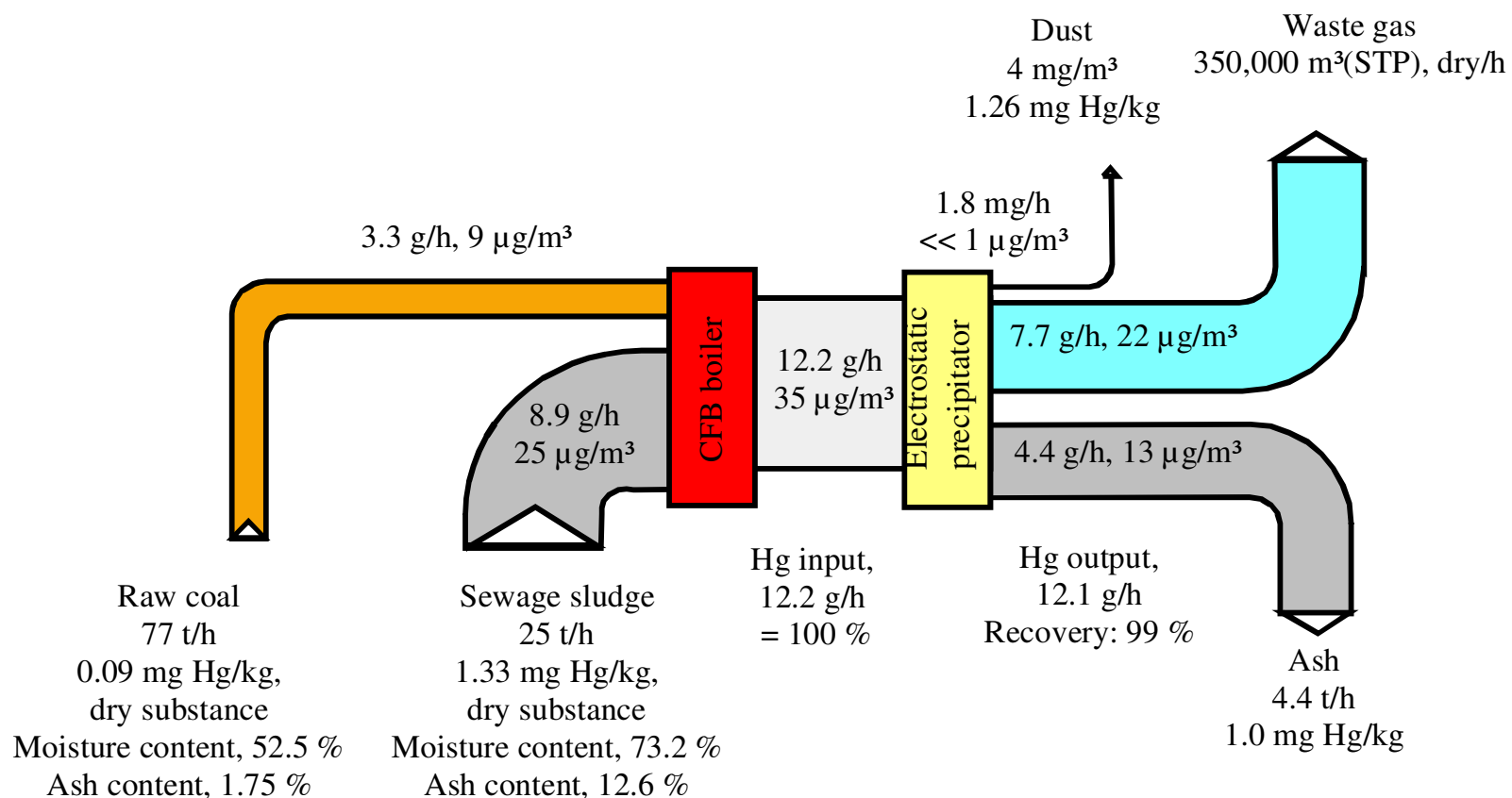


Hg Capture Berrenrath 4 Field ESP

Field 1	Field 2	Field 3	Field 4
30 – 60%	50 – 90%	10%	Detection Limit



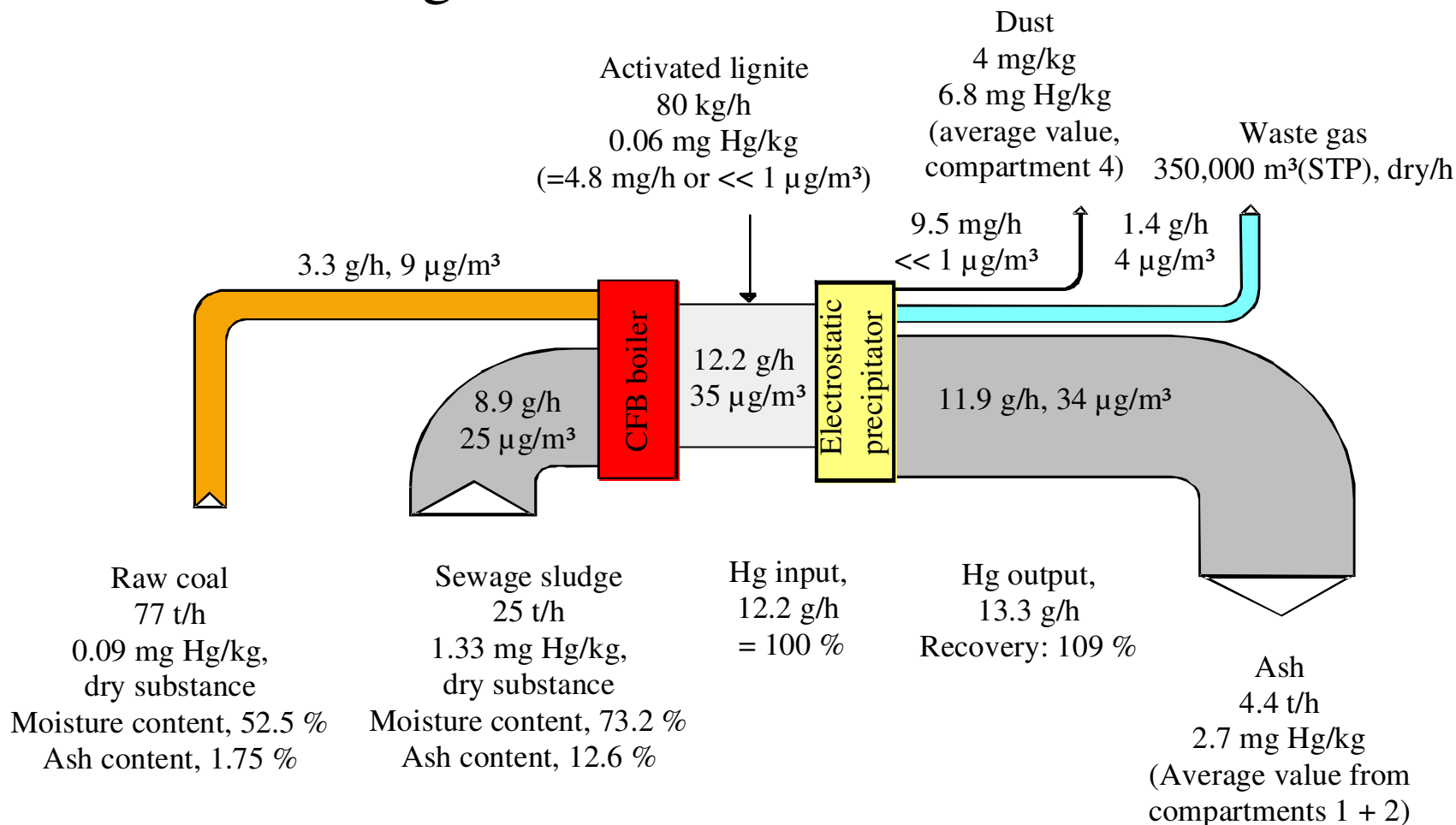
Berrenrath Mass Balance w/o HOK





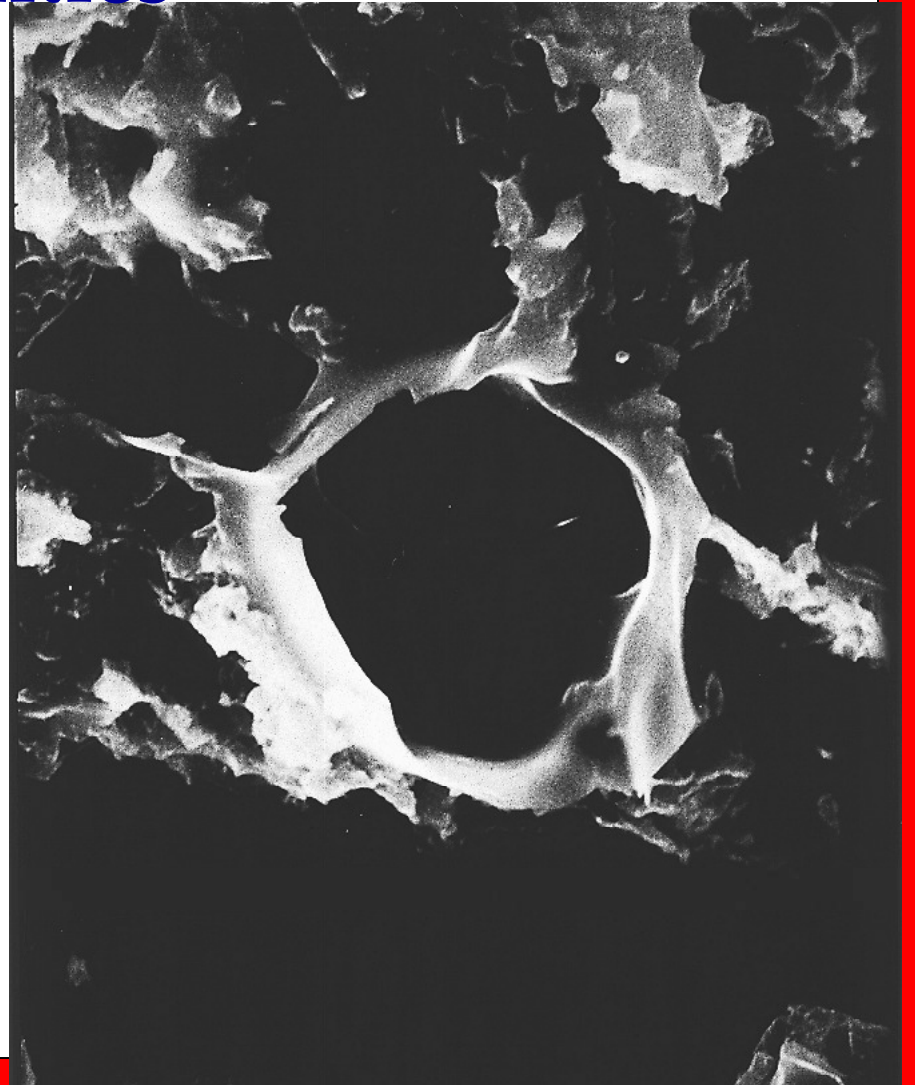
Berrenrath

Hg Mass Balance with HOK



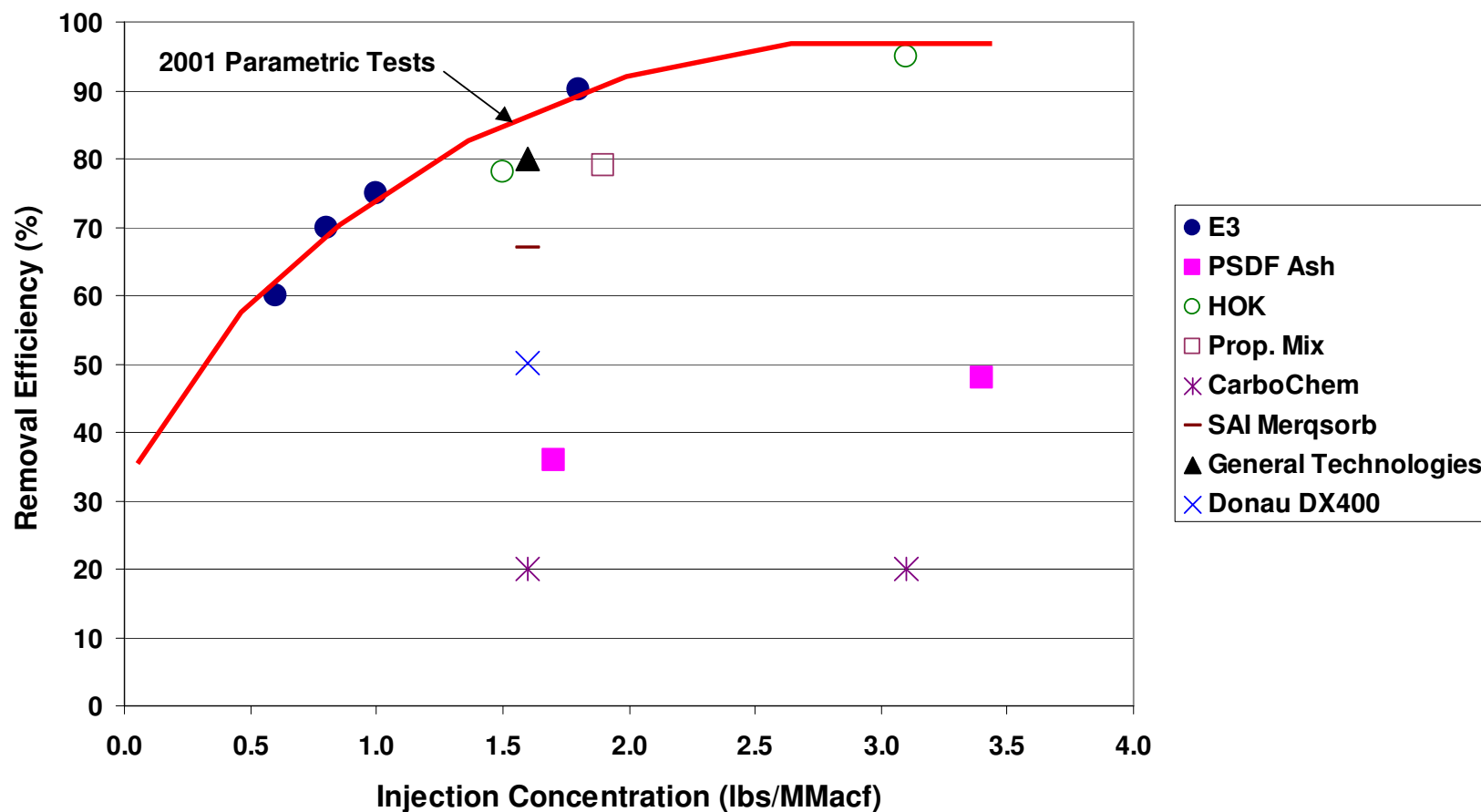


Mercury Control with HOK Technology in US Facilities





Results from parametric testing of RWE HOK Super at Gaston Unit 3B COHPAC[®], June 2004.





Current US Applications

- Utility
 - 2 x 400 MW 90% removal
 - 2 x 165 MW 90% removal
- Waste-to-Energy
 - 15 plants



Technology Development

- HOK
 - Super 23 micron
 - Pulverized – ESPs
- Enhanced
 - Brominated
 - Sulfur impregnated



Current European Hg Trends

- Germany
 - Monitoring
 - All coal fired plants have FGD
 - Bituminous plants have SCRs
 - 30 $\mu\text{g}/\text{Nm}^3$
- Netherlands
 - Permitting new plants

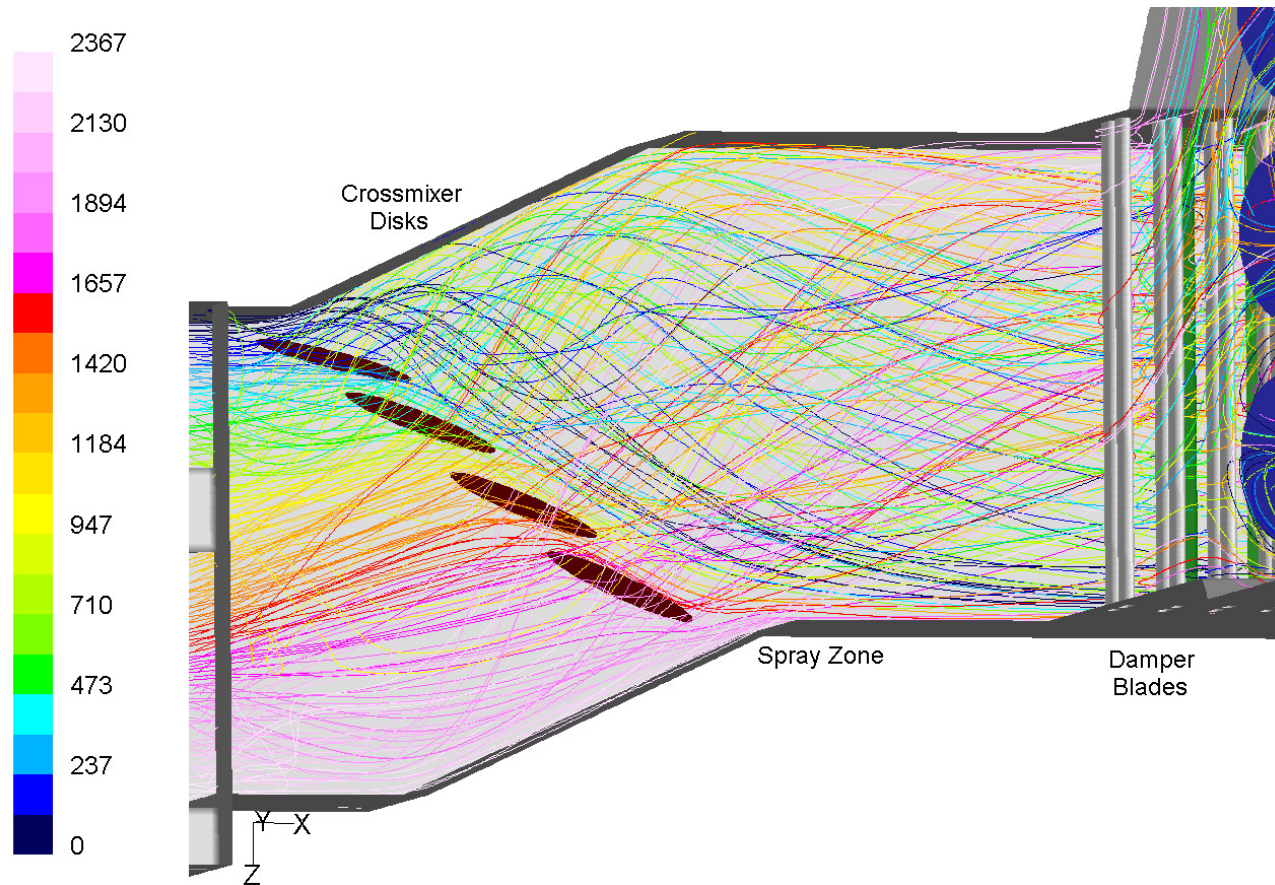


ACI/HOK Injection Concepts

- Mass transfer and contact is a key component in obtaining high Hg removal rates.
- BPEI has developed concept of maximum mixing with minimal injection points
- Use Delta Wing technology for maximum mixing/contact

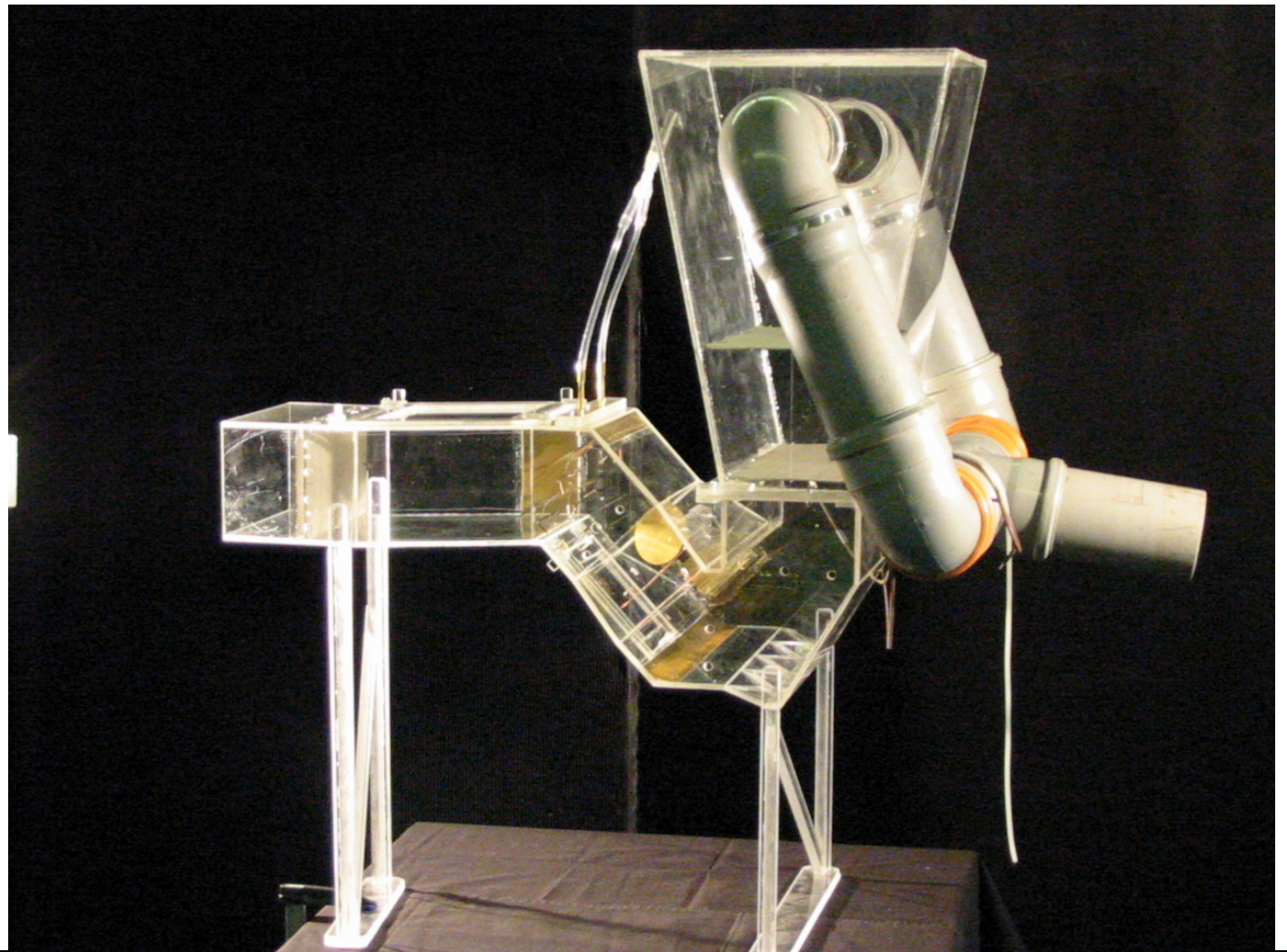


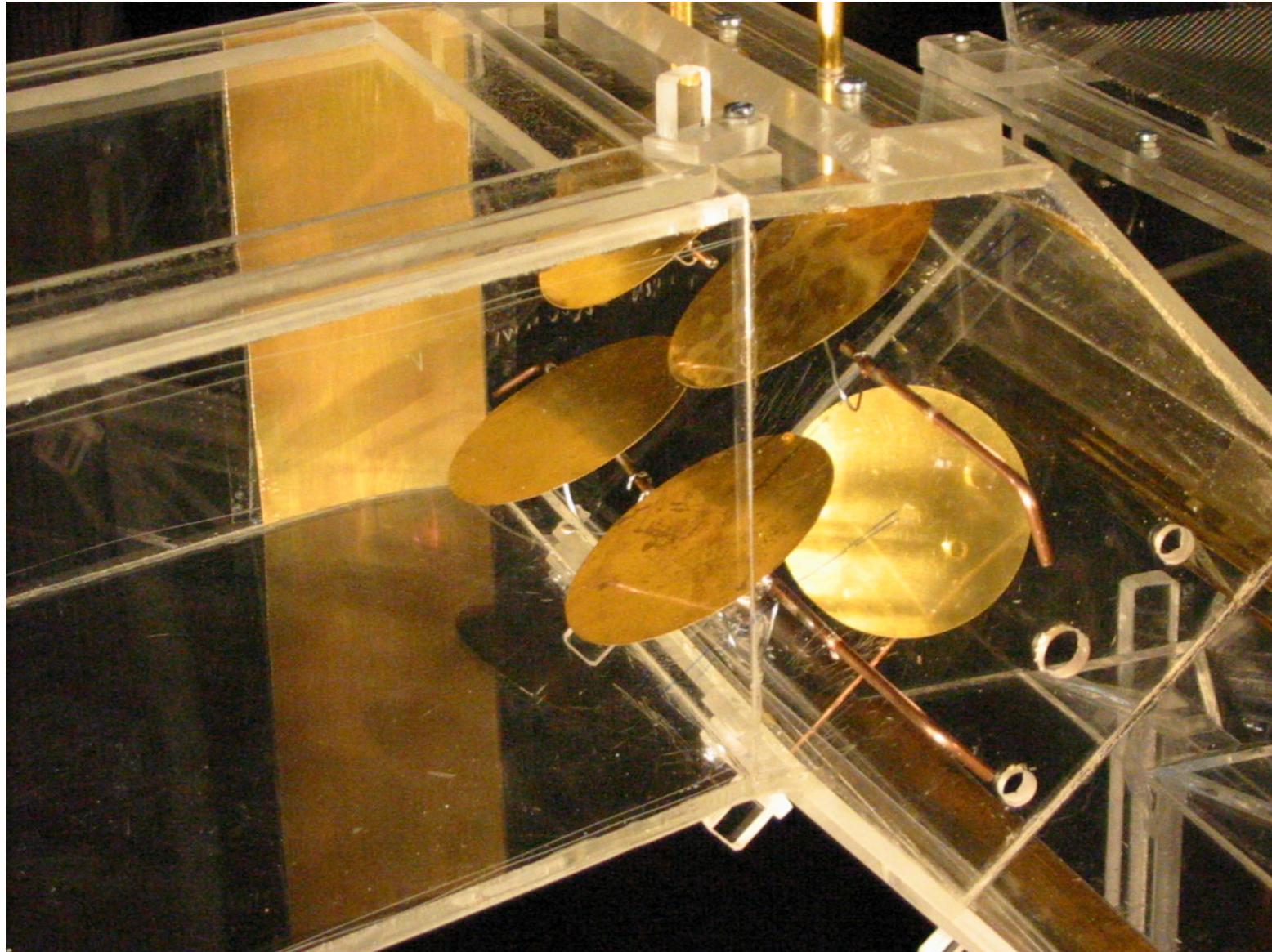
Delta Wing Mixers





Model of Delta Wing Mixers (total 8 nozzles for 800 MW)







Thank You