

Influence on the Fine Particle Formation using Coal Fly Ash as Additive for the Combustion of woody Biomass in Two Full-Scale Boilers

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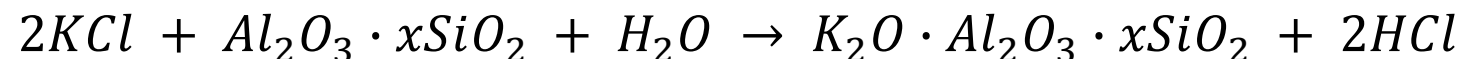
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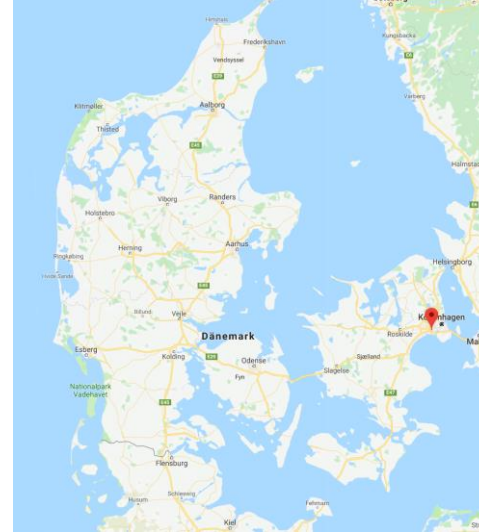
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Full-Scale Experiments at Avedøre Unit 2 & Studstrup Unit 3

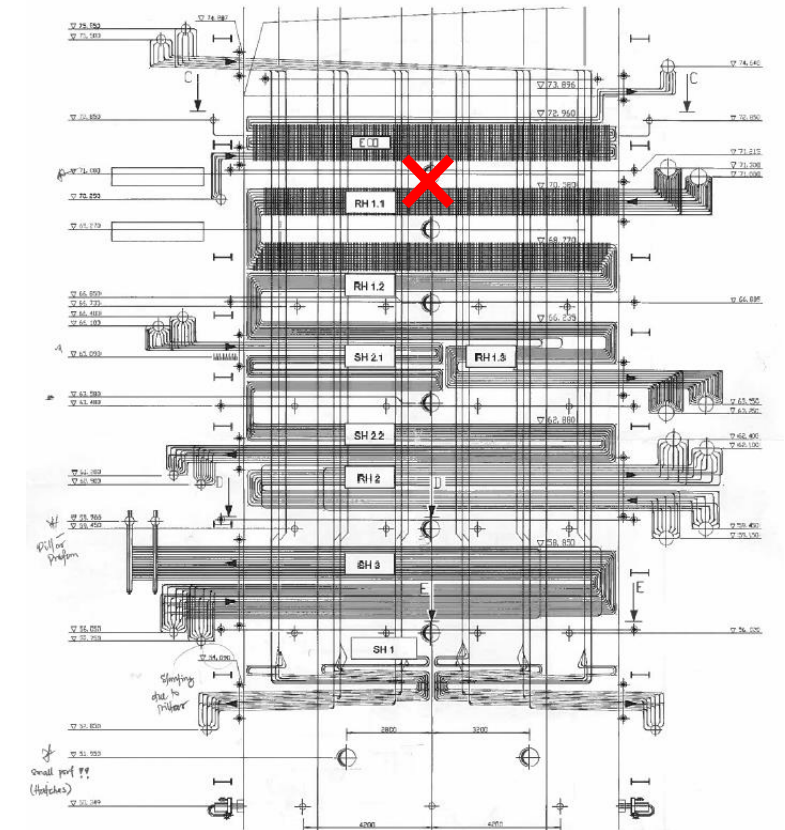
- Full-Scale Measurements were performed in the framework of the Horizon2020 Bioefficiency Project
- Both are CHP plants using pulverized wood pellets as fuel and coal fly ash as additive
- Experimental campaign has been carried out in February 2019
- Goal: Sampling of fly ash and Fine Particles in the reheater section of both boilers
- Effect of coal fly ash insertion on alkali capture: The coal fly ash insertion was varied:
(2.50 / 1.75 / 1.00) wt.% for AVV2
(3.00 / 2.00) wt.% for SSV3 (dry/dry on fuel basis)



Avedøre Unit 2 – 800 MW_{th} Copenhagen



Fine particle measurement with ELPI at reheater section

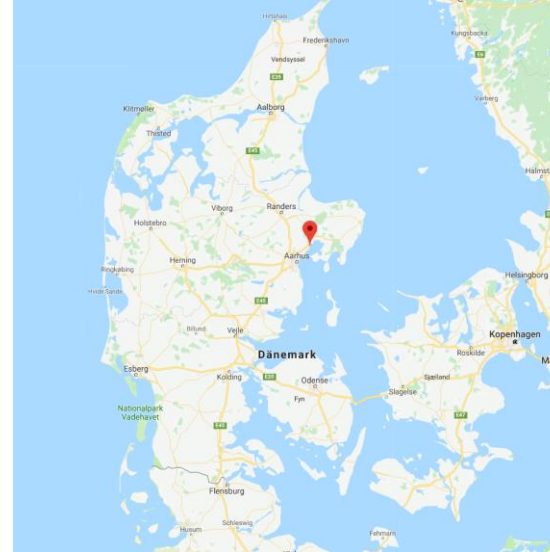


- Tangential fired boiler with 16 swirlburners
- Single-pass design
- Coal fly ash addition with nozzles over burner

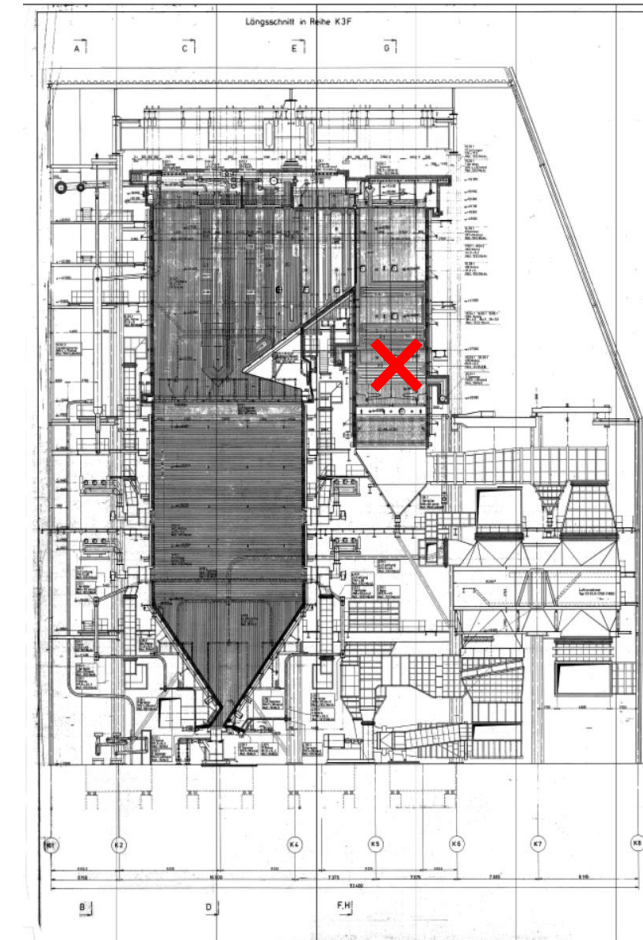
Studstrup Unit 3 – 900 MW_{th} Aarhus



- Boxer fired boiler with 24 swirlburners
- Double-pass design
- Coal fly ash addition with slurry in mill



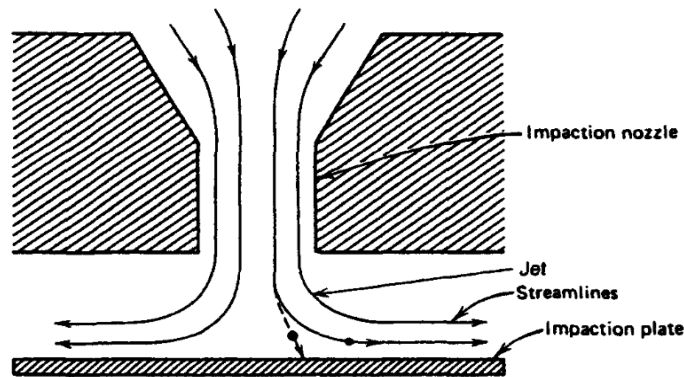
Fine particle measurement with ELPI
at reheater section



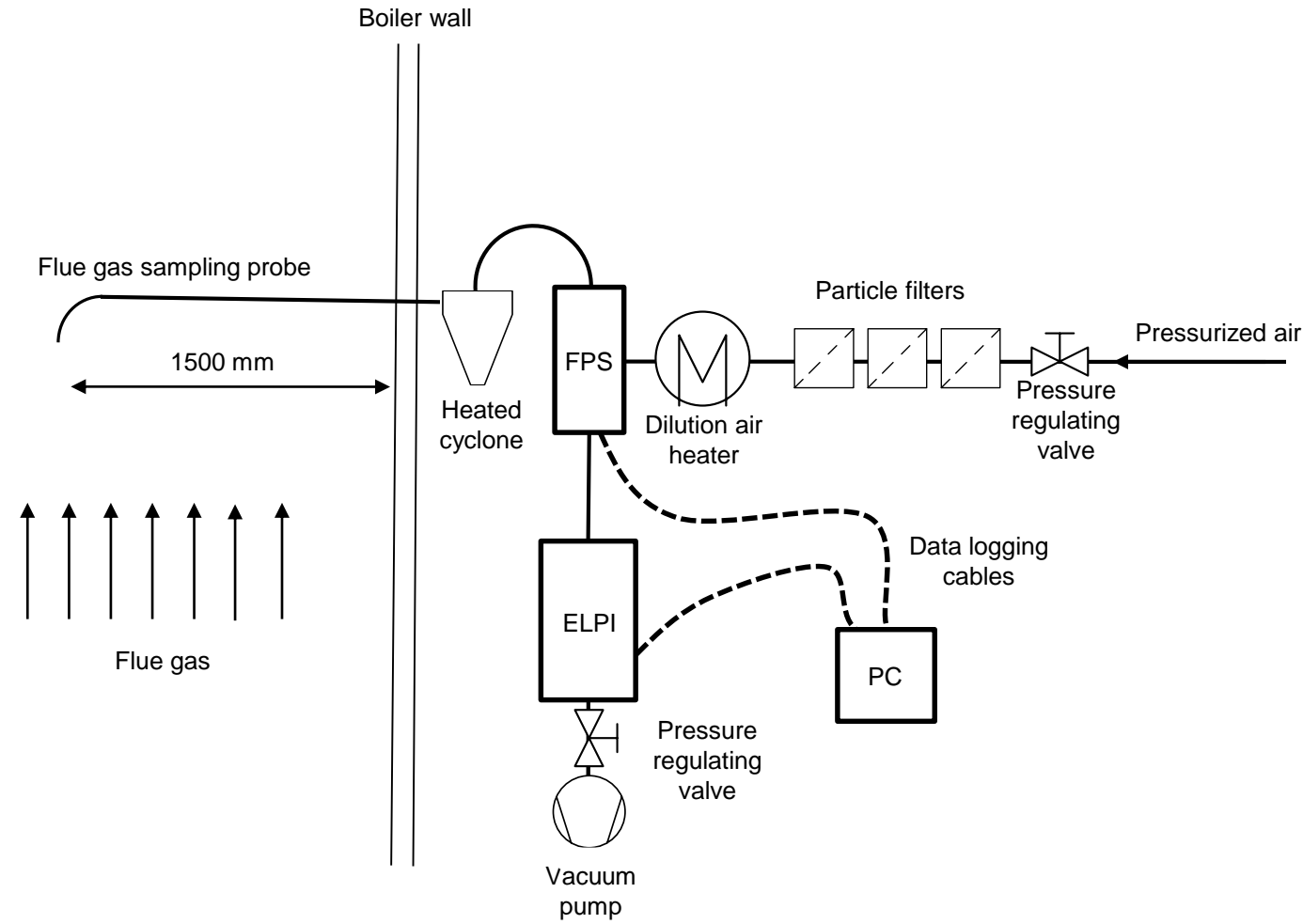
Experimental Setup ELPI Measurements

ELPI (Electrical Low Pressure Impactor)

- Separation of particles $> 10 \mu\text{m}$ with heated cyclone
- Classification of the particles in impactor cascade (0,007 – $6 \mu\text{m}$ in 12 stages)
- Two measurement modes:
 - Online particle size distribution (sinter metal plates)
 - Collection of particles on greased copper foils for analysis with SEM/EDX

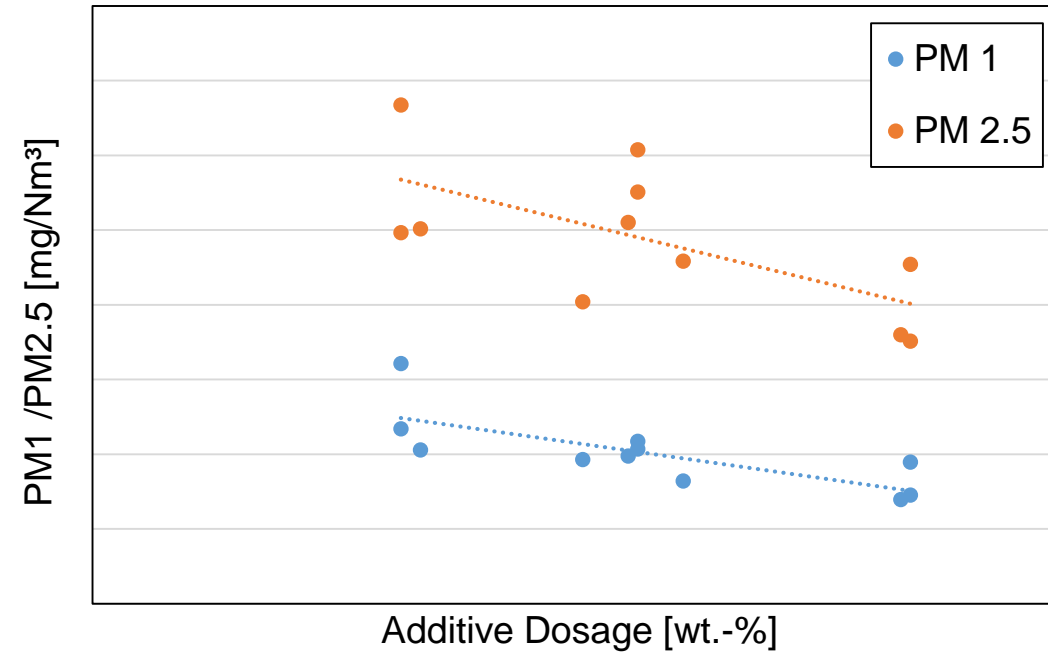


Separation principle in impactor cascade (Hinds et. Al 1999).



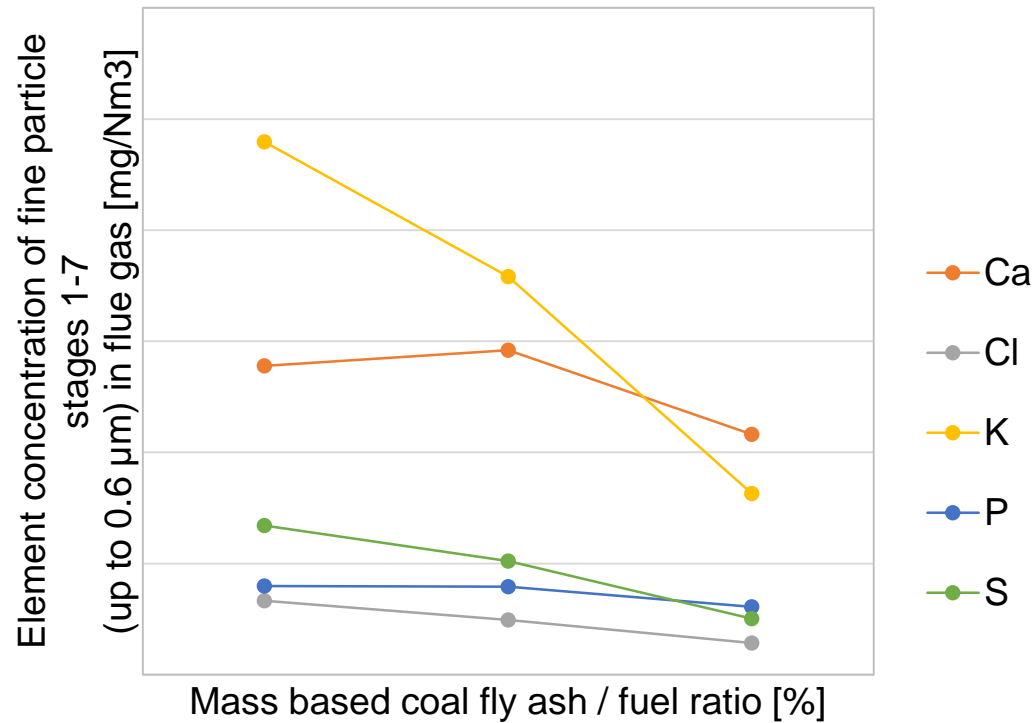
Experimental setup for the fine particle measurements in the CHP plant Avedøre Unit 2.

Results – particle mass load in the flue gas at Avedøre Unit 2

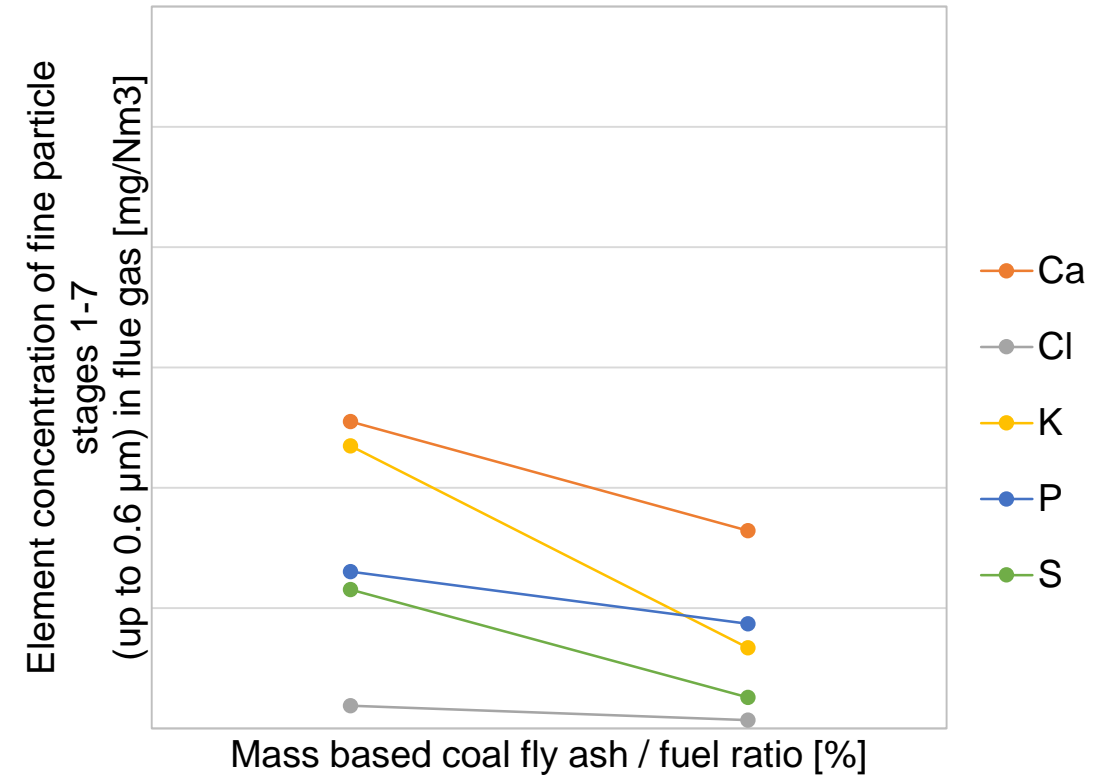


Results of Experiments

Avedøre Unit 2

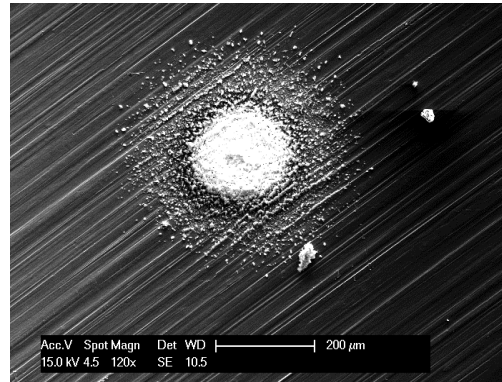
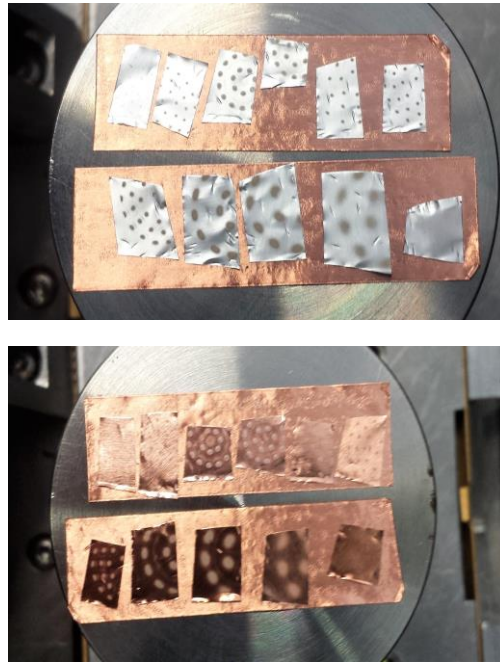
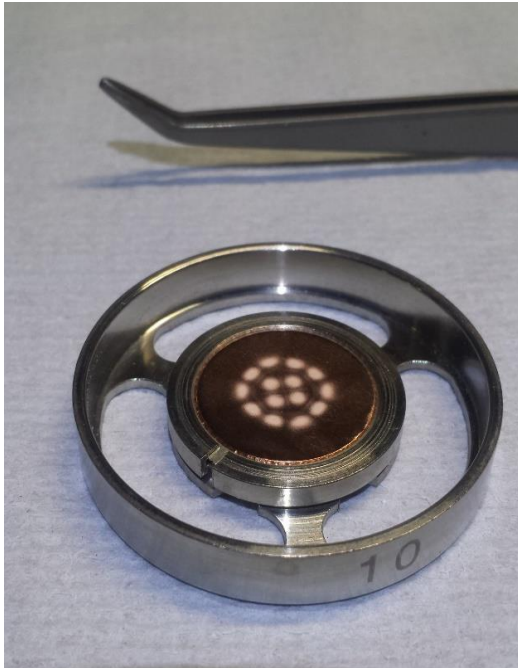


Studstrup Unit 3

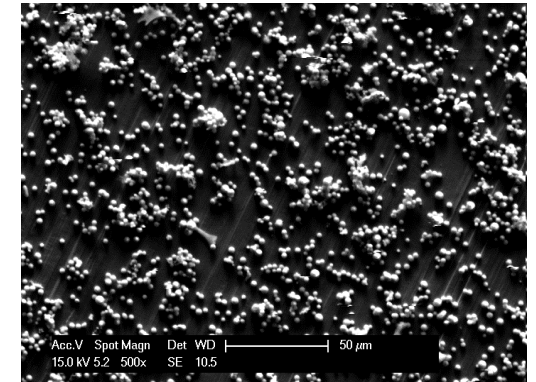


- Over proportional reduction of potassium in fine particles
- No saturation reached with the investigated additive concentration

SEM/EDS Evaluation of Fine Particulates in Flue gas Reheater Avedøre



Collected fine particles of stage 2 on copper target sampled at Avedøre



Collected fine particles of stage 11 on copper target sampled at Avedøre

Conclusion

- Increased CFA/fuel ratio decreases formation of submicron combustion aerosols
- The composition of submicron particles changed with the addition of coal fly ash to Ca, Al and Si rich (less K)
- Not easy to compare the results between the boilers due to different boiler design



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Thank you for the attention!



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