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# **IHCaL Pilot Testing at the TU Darmstadt**

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ANICA - Workshop on advanced CO<sub>2</sub> capture technologies for cement and lime industries

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Experimental Validation of the IHCaL process ANICア







- Validation of IHCaL in industrially relevant conditions for power plants (TRL 5)
- Over 90 % CO<sub>2</sub> capture efficiency
- Same sorbents, low CO<sub>2</sub> avoidance costs expected

Source. M. Reitz et al., Design and operation of a 300 kWth indirectly heated carbonate looping pilot plant, Int. J. Greenhouse Gas Control, 54 (2016) 272-281.



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### **Aim of Pilot Testing**





Demonstration of the IHCaL process for integration into lime and cement plants (TRL 6)

- Long-term pilot testing at 300 kW<sub>th</sub> under real conditions; same fuels, sorbents and operating conditions
- Determine operating conditions for the industrial applications
- Determine the long-term performance of sorbent and heat pipes
- Provide experimental data for validation of 1D/3D models



Pilot-scale heat pipe (2 m)



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# **IHCaL Pilot Plant - Experimental Setup**





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## IHCaL Pilot Plant -Existing Reactor System





#### **Auxiliary System** Flue gas air Air Air quench Quench Quench Aiı Gas Analysis Gas Analysis Cyclone Carbonator Cone Valve Combustor L-Valve Calciner LS 15 **Heat Pipes**

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# IHCaL Pilot Plant -Existing Reactor System





# Auxiliary System

- Flue gas air quench
- Fluidisation with preheated air



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# IHCaL Pilot Plant -Existing Reactor System





### **Auxiliary System**

- Flue gas air quench
- Fluidisation with preheated air
- Propane firing up to 300 kW<sub>th</sub>





#### Adaptions of the Pilot Plant (I)







#### Flue gas path

- Cooling to 180°C
- Dedusting
- Pressure increase up to 450 mbar
- Fluidisation of carbonator
- Mixture of flue gas and CO<sub>2</sub> up to 25 Vol-%



#### Adaptions of the Pilot Plant (II)







#### Solid Feedstock Feeding

- Sealed system with rotary valve
- Continuous dosing with loss-in-weight feeder
- Feeding with screw conveyer into lower part of reactor
- Additional fueling with solid recovered fuels



#### Adaptions of the Pilot Plant (III)







#### Make-Up/ Purge System

- Controlled loss-inweight-feeding via calciner
- Discharging of CaO via LS with speed controlled screw

Simultaneously and continuously purging and feeding of different sorbents



#### Adaptions of the Pilot Plant (IV)







#### **Steam fluidisation**

- Replace air with H<sub>2</sub>O as additional fluidisation agent into calciner
- Decrease heat demand of calciner
- Decrease fuel supply to combustor



#### **Summary & Outlook**

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- Design adaptions of 300 kW<sub>th</sub> pilot plant for cement and lime applications
- Installation of main components
- 3 long-term pilot tests of 2 weeks in industrially relevant conditions



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#### Consortium







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#### Thank you for your attention!





