

IEEE East Coast Conference 2022

# PLC AND POZZOLAN CEMENTS - FLSMIDTH PERSPECTIVE

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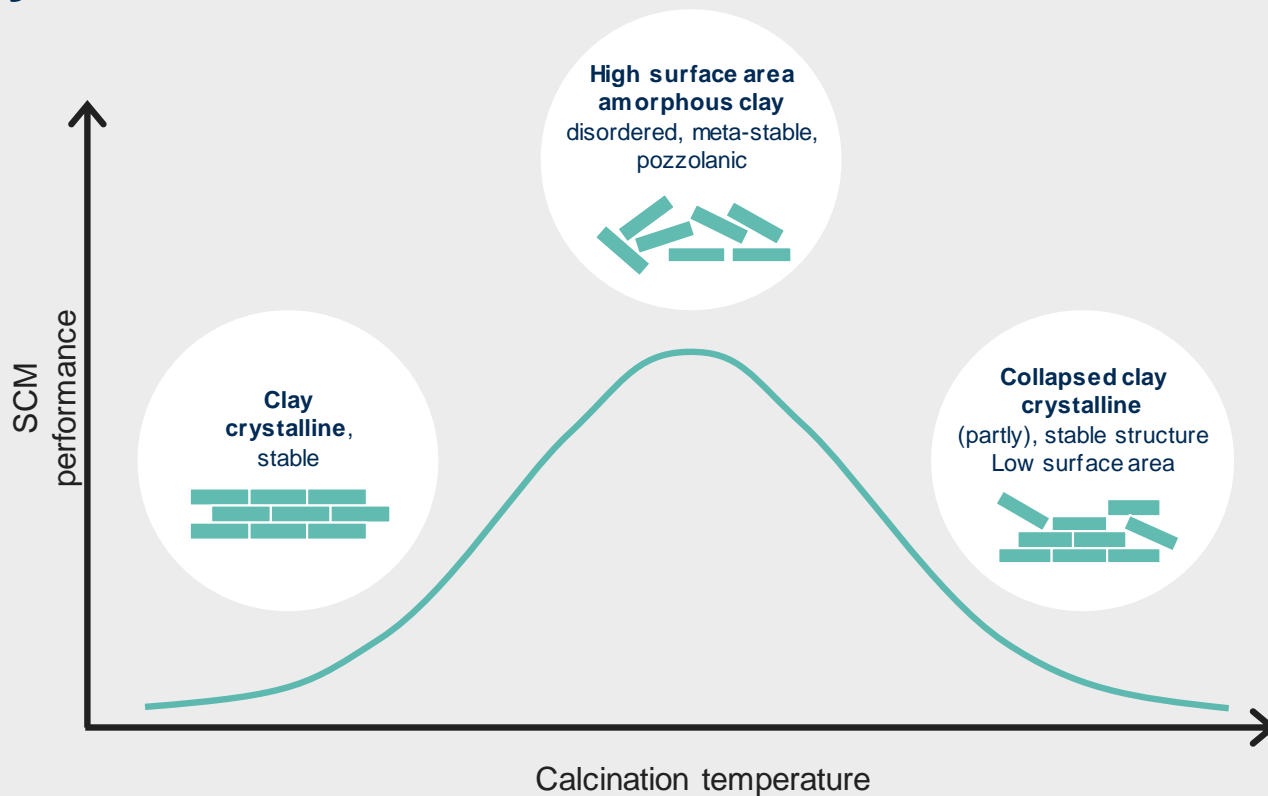
WE DISCOVER POTENTIAL

**FLSMIDTH**

# Agenda

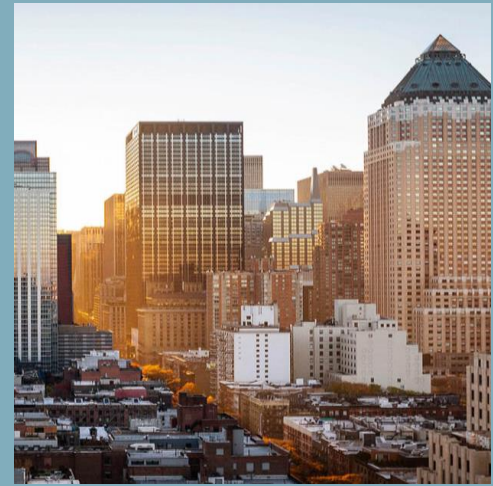
- What is clay calcination
- Drivers and roadblocks for calcined clay
- Clay sourcing
  - Confirming a good clay source
  - Pilot testing
- Clay Calcining technology
- Influence of clay feed moisture
- Conclusion

# Clay Calcination



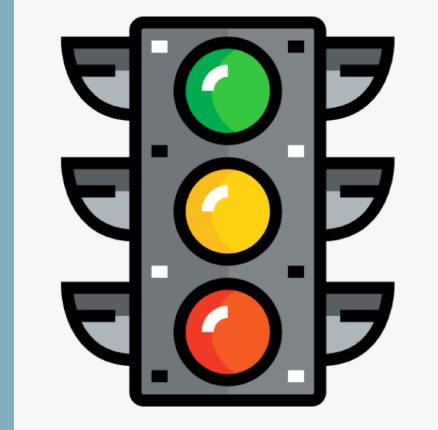
# Drivers for calcined clay projects

- “Green” Cement:
  - Lower CO<sub>2</sub> emissions
  - CO<sub>2</sub> credits
- Small production increase:
  - Lower CAPEX and OPEX per ton of cement
  - Lower CO<sub>2</sub> emissions
- Reduced availability of fly ash and slag
- Limestone unavailable locally



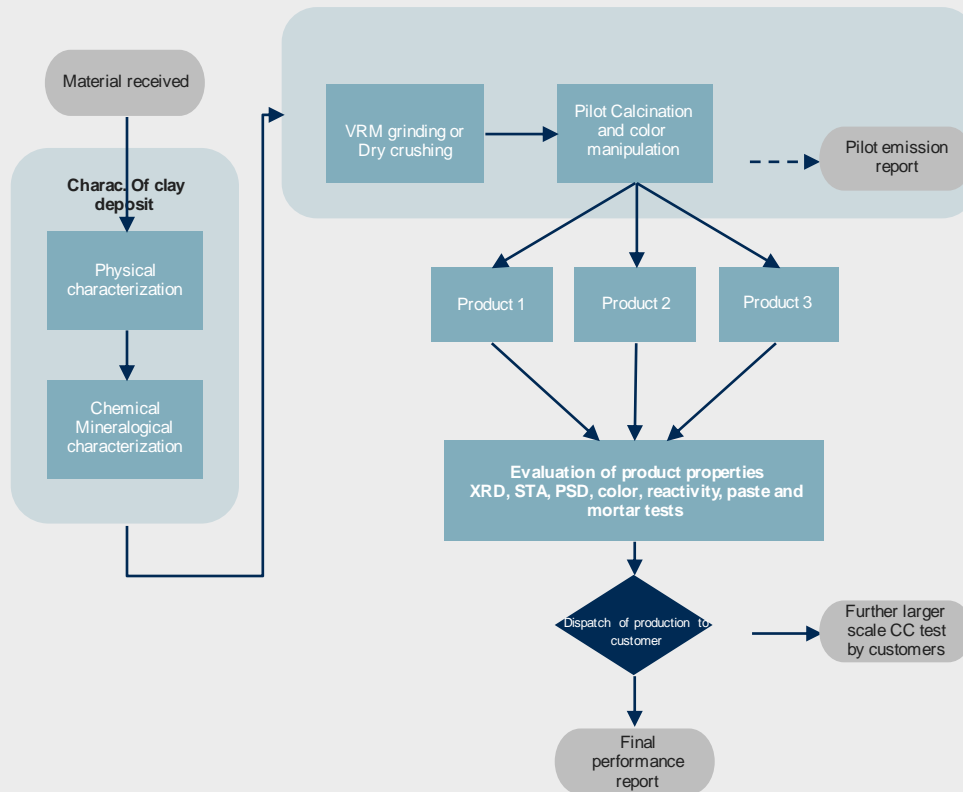
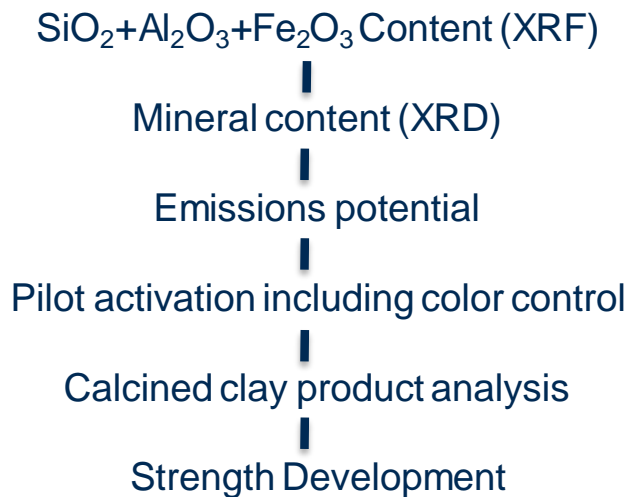
# Potential roadblocks and challenges

- Slag or fly ash are readily available
- Cement/concrete codes / Lack of familiarity with calcined clay in cement and concrete with end users
- Permitting – Follow cement emissions/permitting rules or something else?
- Clinker replacement or concrete additive?



# Clay performance evaluation – Not all clays are equal!

## Clay SCM Potential Viability



# Pilot Testing of Calcined Clay

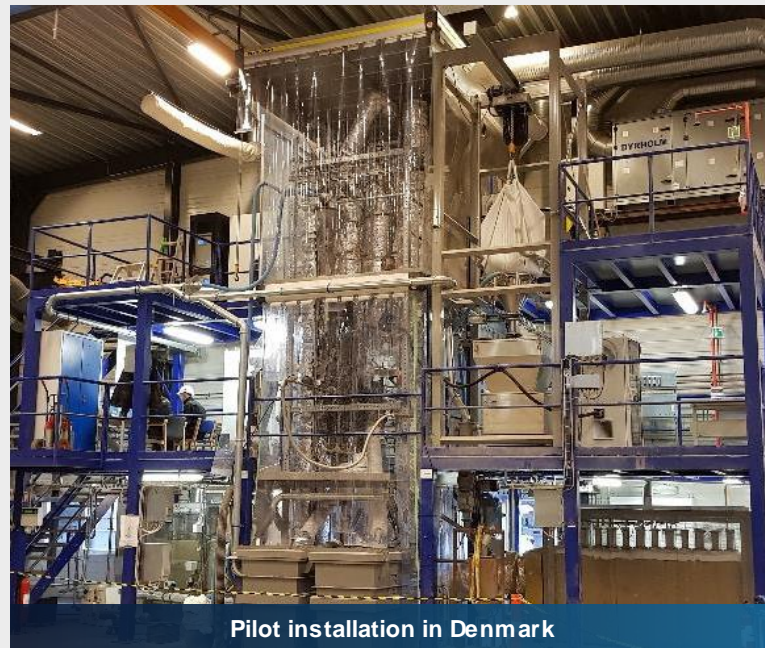
- Larger scale testing of clay to prove quality potential, color control, and emissions
- Both cement and concrete quality testing
- Proof of large-scale installation



**Without color  
control**



**With color  
control**

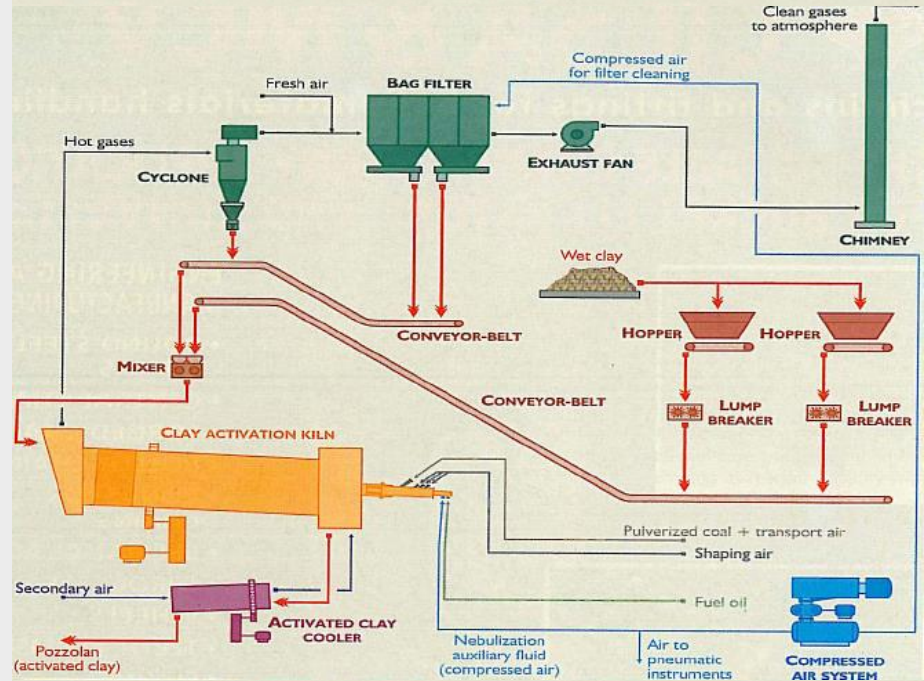


# Production using a kiln system - Older technology

## Challenges

- Wet “lumpy” material fed to kiln
- Uneven heating of clay
- Change of color
- Inconsistent calcination

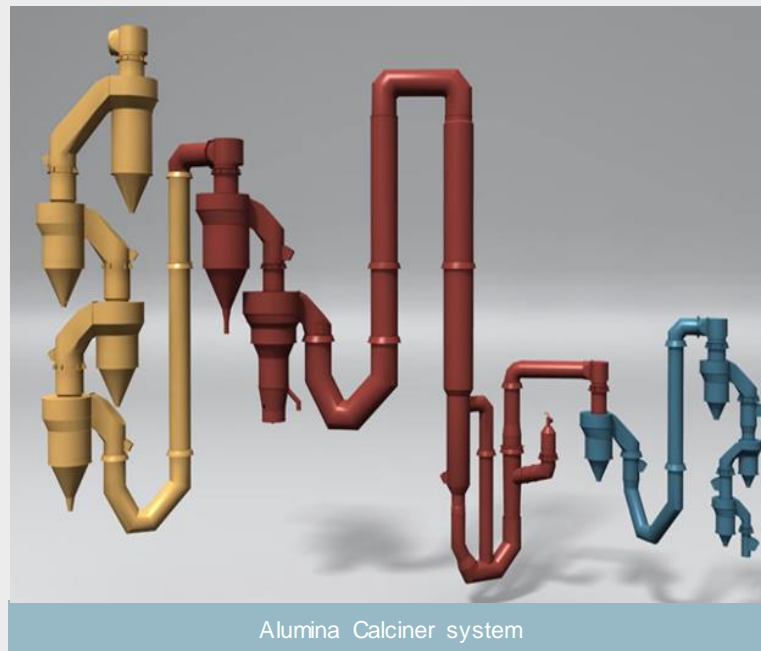
Limits the % substitution into finished cement



*From “Pozzolan Production” by C. Greco and G. Picciotti, World Cement October 2001*

# Inspiration for modern clay calciner

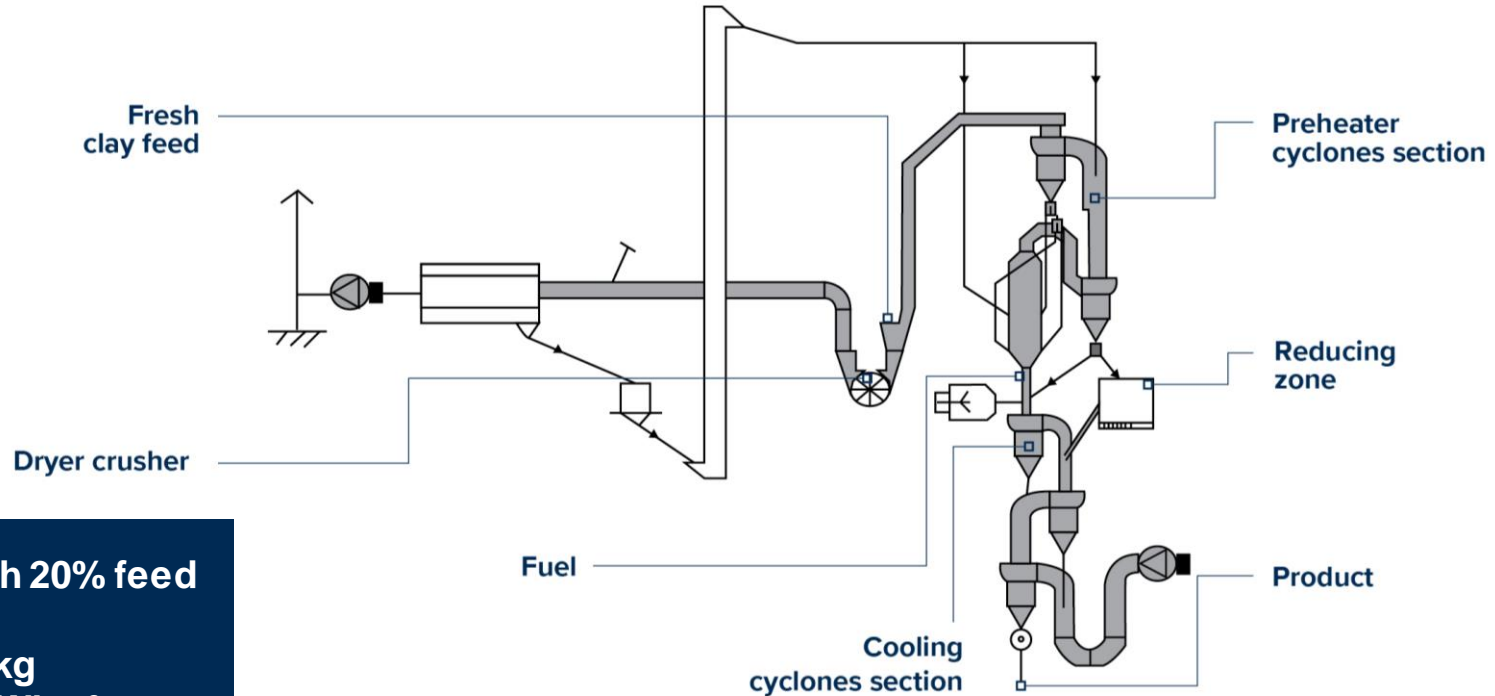
- Alumina calciners have been used for 30+ years with 40+ references worldwide
- Efficiency and stability benefits of preheater/calculator operation with cooler heat recovery



Alumina Calciner system

# Clay Gas Suspension Calciner (GSC)

- patent pending



**Expected OPEX with 20% feed  $H_2O$  and 10% LOI:**

- Fuel ~ 425 kcal/kg
- Power ~ 12-14 kWht for dryer/crusher and fans

# Expected benefits of a GSC versus a kiln

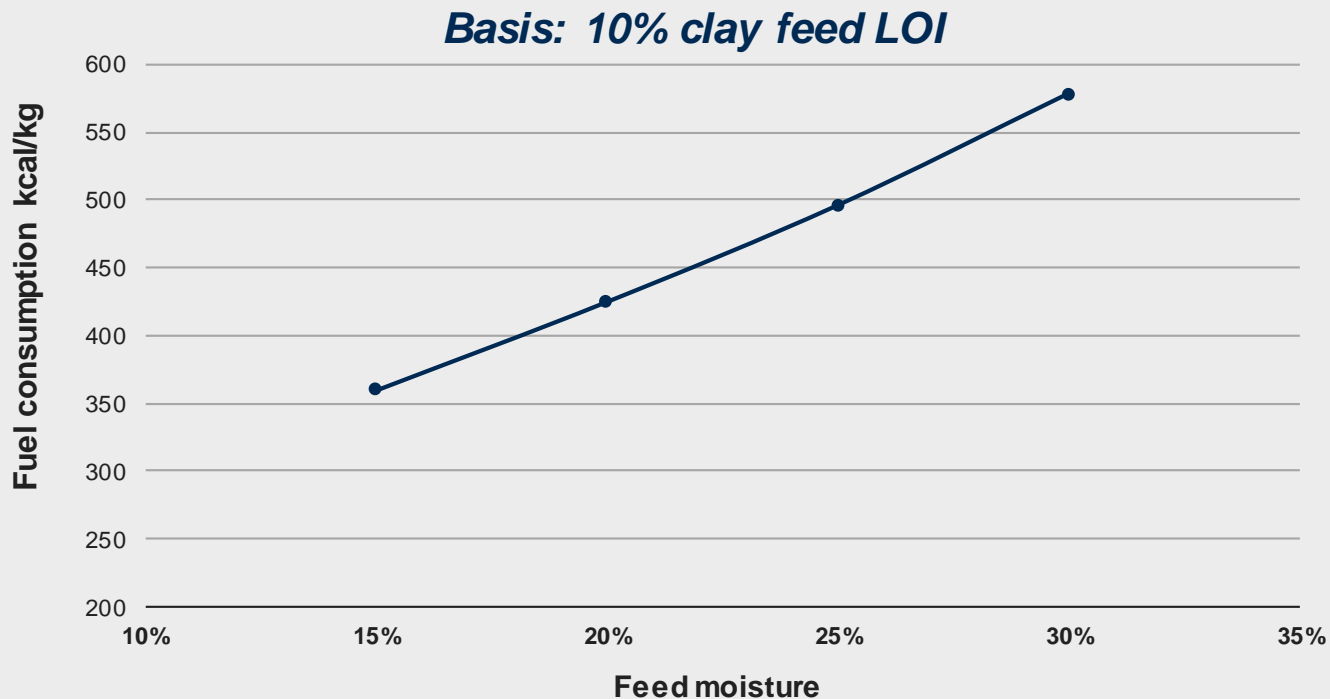
- Higher quality product due to more consistent calcination
- Higher mix percentage of calcined clay into blended cement
- Lower fuel and maintenance costs
- Greater fuel flexibility for burning waste fuels
- Smaller footprint for a new system
- Lower total cost of ownership for a new system

# Typical 3D layout



# Impact of clay moisture on fuel consumption

Clay GSC system w/ heat recuperation (patent pending)



# Comparison of OPC and LC<sup>3</sup> Cement

## OPEX Benefits (per ton of cement)

	OPC (95% clinker / 5% gypsum)	LC <sup>3</sup> (50% clinker/ 15% limestone / 30% activated clay / 5% gypsum)	Impact
Fuel consumption kcal/ kg	684	468*	>30% decrease in fuel
Power consumption kWh/t	85	51	~40% decrease in power
CO <sub>2</sub> reduction kg/kg:			
Raw material	0.50	0.25**	
Fuel***	0.26	0.18	
Power	0.06	0.04	
Total CO <sub>2</sub> emission kg/kg	0.82	0.47	>40% specific reduction
Cement capacity index	100	100-190	Make more cement w/ same clinker or same cement w/ less clinker

• Based on 15% moisture and 10% LOI in the raw clay

\*\* excludes carbonate and organic content in clay (traces may be expected)

\*\*\* excludes "neutral" CO<sub>2</sub> fuels

# Comparison of PLC and LC<sup>3</sup> Cement

## OPEX Benefits (per ton of cement)

	PLC (85% clinker / 10% limestone/ 5% gypsum)	LC <sup>3</sup> (50% clinker/ 15% limestone / 30% activated clay / 5% gypsum)	Impact
Fuel consumption kcal/ kg	<b>612</b>	468*	<b>&gt;24%</b> decrease in fuel
Power consumption kWh/t	<b>76</b>	51	<b>~33%</b> decrease in power
CO <sub>2</sub> reduction kg/kg:			
Raw material	<b>0.45</b>	0.25**	
Fuel***	<b>0.23</b>	0.18	
Power	<b>0.05</b>	0.04	
Total CO <sub>2</sub> emission kg/kg	<b>0.73</b>	0.47	<b>&gt;35%</b> specific reduction
Cement capacity index	100	100-190	Make more cement w/ same clinker or same cement w/ less clinker

• Based on 15% moisture and 10% LOI in the raw clay

\*\* excludes carbonate and organic content in clay (traces may be expected)

\*\*\* excludes "neutral" CO<sub>2</sub> fuels

# Conclusion

**Calcined Clay is  
a cost-effective  
way to increase  
production  
and/or reduce  
CO<sub>2</sub> emissions**



Quality product with color  
similar to cement - higher  
substitution rates



Lower capital &  
operating costs



High system flexibility  
Low maintenance



More environmentally  
friendly sustainable  
products

# Thank you



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