Decarbon technologies development

West Coast Cement Industry Conference – Provo Utah – 19.10.2023

Luc Rudowski

#grey2green portfolio – greentechs solutions under industrial development

less clinker + carbon capture → more green SCMs or Novel cements

Carbon capture
- ✓ Amine scrubbing
- ✓ Oxyfuel – Pure oxyfuel
- ✓ Crogenic capture
- ✓ Indirect heating
- ✓ Calcium looping

SOC

PolabCal

Fine Grinding / Separation / Separate Grinding
- ✓ Agitated bead mill – Booster mill
- ✓ Ultrafine separators / Mixers

New AC technology

Novel cements – Zero clinker cements
- ✓ Alkali-activated
- ✓ Hydroxy calcium silicates
- ✓ Mg silicates (olivine)
- ✓ Wollastonite

SCMs
- ✓ Activated clay
- ✓ Ultrafine or activated pozzolan
- ✓ Ultrafine zeolite and perlite
- ✓ Ultrafine limestone
- ✓ Vaterite – Fortera
- ✓ Fly ash
- ✓ Bottom ash
- ✓ Granulated blast furnace slag
- ✓ Metal and steel slags
- ✓ Carbonated recycled concrete fines

- ✓ Recycled concrete aggregates/fines
- ✓ Recycled concrete as raw material

electrical heating

Power2heat

solar calciner

Hydrogen

biomass

Alternative fuel – Prepol SC

Energy (renewable)

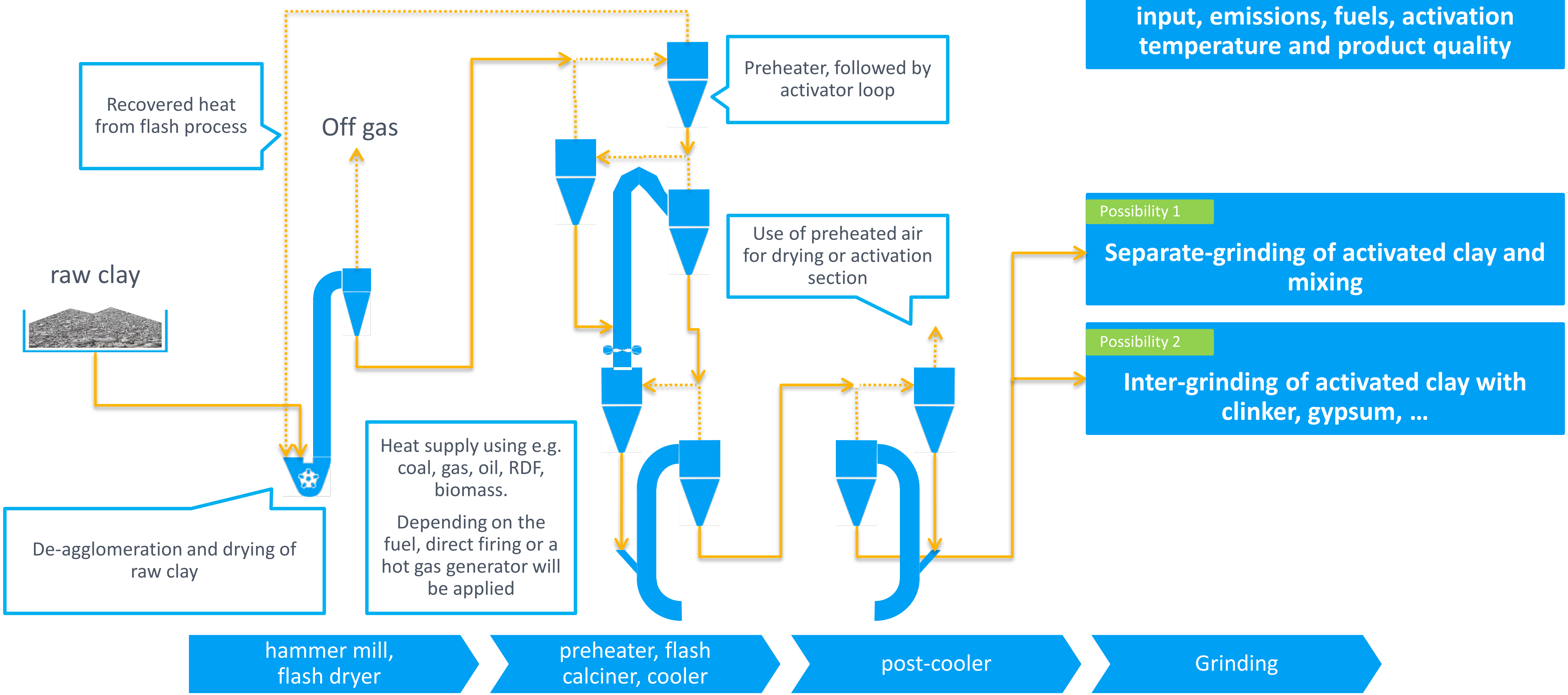
Circularity

* Supplementary Cementitious Materials

Activated clay

General flow sheet of a flash activation process

Detailed process design based on individual boundaries like raw clay input, emissions, fuels, activation temperature and product quality

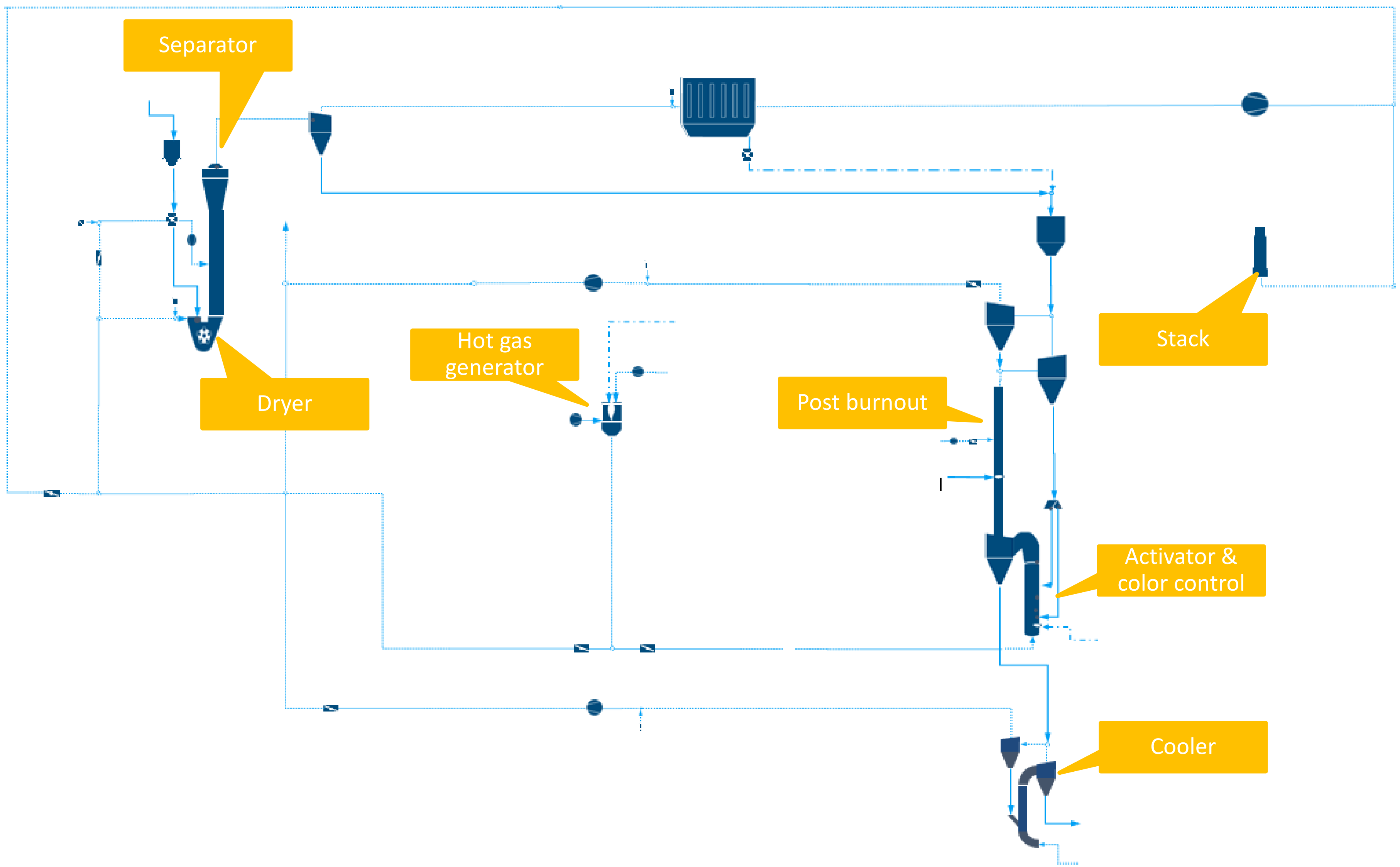


polysius activated clay processes

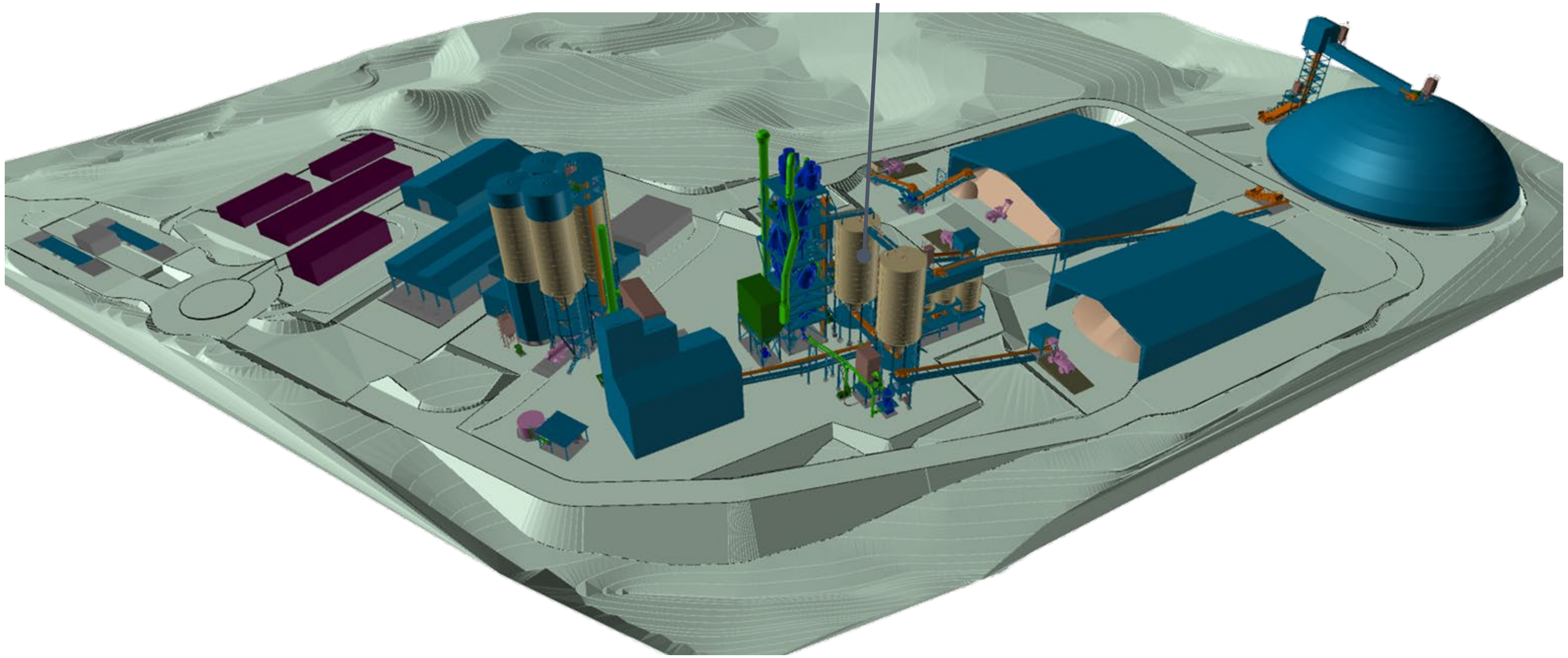
Direct color control while activation

Medium-high target darkness

Suitable fuel for direct reduction (oil, gas, lignite, volatile coals, …)



Cimpor Cameroon - First industrial-size stand alone flash activator



- Launching of activated clay task force two years ago
- "world's first green field EPC flash activation plant" 720tpd to be commissioned in October 2023
- Continuous improvement of the system while execution phase
  - Plant design review
  - Construction phase starting soon
- Strong market pull from cement and non-cement players

CIMPOR Ghana – 2. tk Polysius reference – World‘s largest flash activator for clays

… contract signed … "tk Polysius to build the worlds largest flash activator"…

Project boundaries

- 1.280 tpd AC production @ clay moisture between 10 % and 20 % w.b.
- Natural gas firing via HGG and gas burners
- Patented "reducing activator technology"
- Scope: From feed bin to AC silos

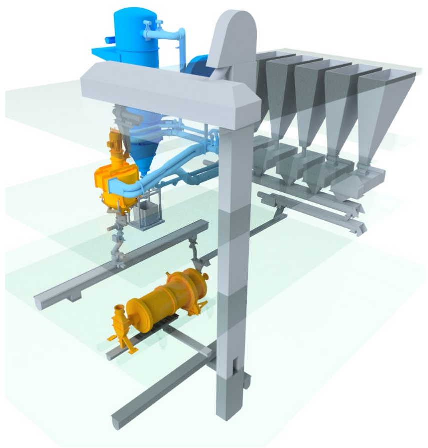
Operation of new AC plant expected in 2025

booster mill

polysius® booster mill

polysius® booster mill applications

- Boost cement fineness to high performance products
- Boost clinker content in cement down
- Boost capacity of existing grinding plants



pure oxyfuel

polysius® pure oxyfuel in a nutshell

What is the technology doing?

- Replacement of combustion air with pure oxygen during clinker production
- Basis for more efficient CO_2 concentration for capture and downstream utilization or storage (CCUS)
- Brownfield project / new build kiln line

Why is it attractive?

- Total cost of ownership advantage compared to other carbon capture technologies
- CO2 reduction potential high >90%*

How is the pipeline?

- pure oxyfuel pilot CI4C @ TRL 7
- pure oxyfuel full scale C2B @ TRL 8
- Pure oxyfuel full scale EU CO_2NTESSA +2 @ TRL 9

Where & when will the plants be operating?

- Germany 2025 (C4C), 2027 (C2B)
- EU 2028 (Funded Titan Kamari, HM Geseke), Nexe
- North America >2030 ?
- Other >2030

CI4C

Pilot
450tpd
2024/25

C2B

Full Sc.
4500tpd
2027

CO_2NTESSA
+others

Full Sc.
3000tpd
2028

* Related to scope 1 emissions