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For a zero-waste future

Alternative Raw Materials in LafargeHolcim

ALiCE online workshop 26th Feb 2021

The global leader in building materials and solutions

Four business segments: Cement, Aggregates, Ready-Mix Concrete and Solutions & Products.

LafargeHolcim

Facts and figures

~80
countries

~2,300
operating sites

~75,000
employees

27.5
billion CHF net sales

All figures Full Year 2018

Listed on **SIX** and **Euronext**

Largest footprint in the industry

● Cement plant ● Grinding plant

All figures Full Year 2018; figures for operating sites include joint ventures

North America	**12,892** employees	**561** operating sites	**CHF 5,875m** net sales
Latin America	**8,956** employees	**143** operating sites	**CHF 2,731m** net sales
Europe	**20,222** employees	**905** operating sites	**CHF 7,554m** net sales
Asia Pacific	**21,979** employees	**533** operating sites	**CHF 7,446m** net sales
Middle East Africa	**11,856** employees	**239** operating sites	**CHF 3,080m** net sales

LH Net Zero Pledge

Leading the way in green construction, LafargeHolcim is the first global building materials company to sign the UNGC's "Business Ambition for 1.5°C" initiative, with a 2030 SBTi-verified action plan.

Our 2030 commitments on our way to net zero

- Accelerate the use of low-carbon and carbon-neutral products such as ECOPact and Susteno
- Recycle 100m tons of waste and by products for energy and raw materials
- Scale up the use of calcined clay and develop novel cements with new binders
- Double* waste-derived fuels in production to reach 37%
- Reach 475 kg net CO_2 per ton of cementitious material (net CO_2/t. cem)
- Operate our first net zero CO_2 cement production facility

** Compared to 2018 baseline.*

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Focused on waste

We are one of the world's largest waste solutions companies. We co-process industrial, municipal and agricultural waste using the high temperatures of cement kilns to recover energy while safely recycling the waste.

In 2020 we co-processed:

52 million tonnes of waste

10 million tonnes as alternative fuel and alternative raw materials in our kilns

2 million tonnes of which was plastic waste

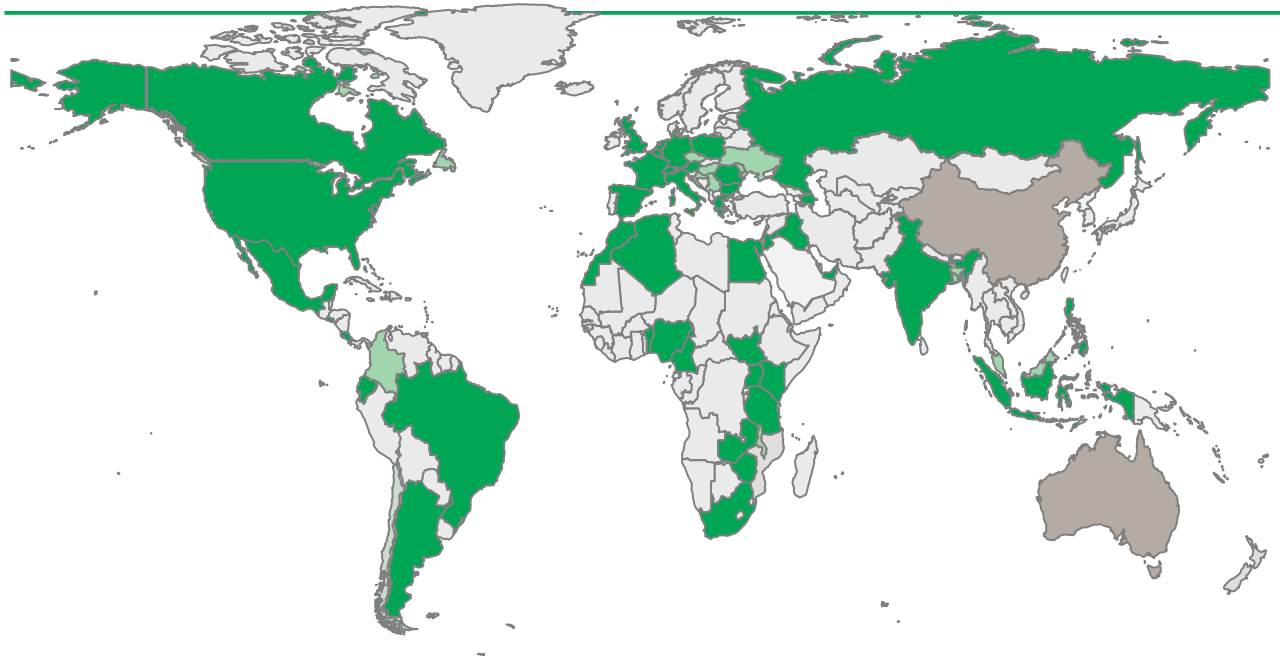
LafargeHolcim operates Waste Management businesses in 51 countries around the world

21% of thermal energy from alternative fuels

51 countries with waste management business

10 M Tons of co-processed waste

Led by Central Corporate function & 5 Regional organizations*



10’000 customers

90 pre-treatment facilities

180+ co-processing facilities

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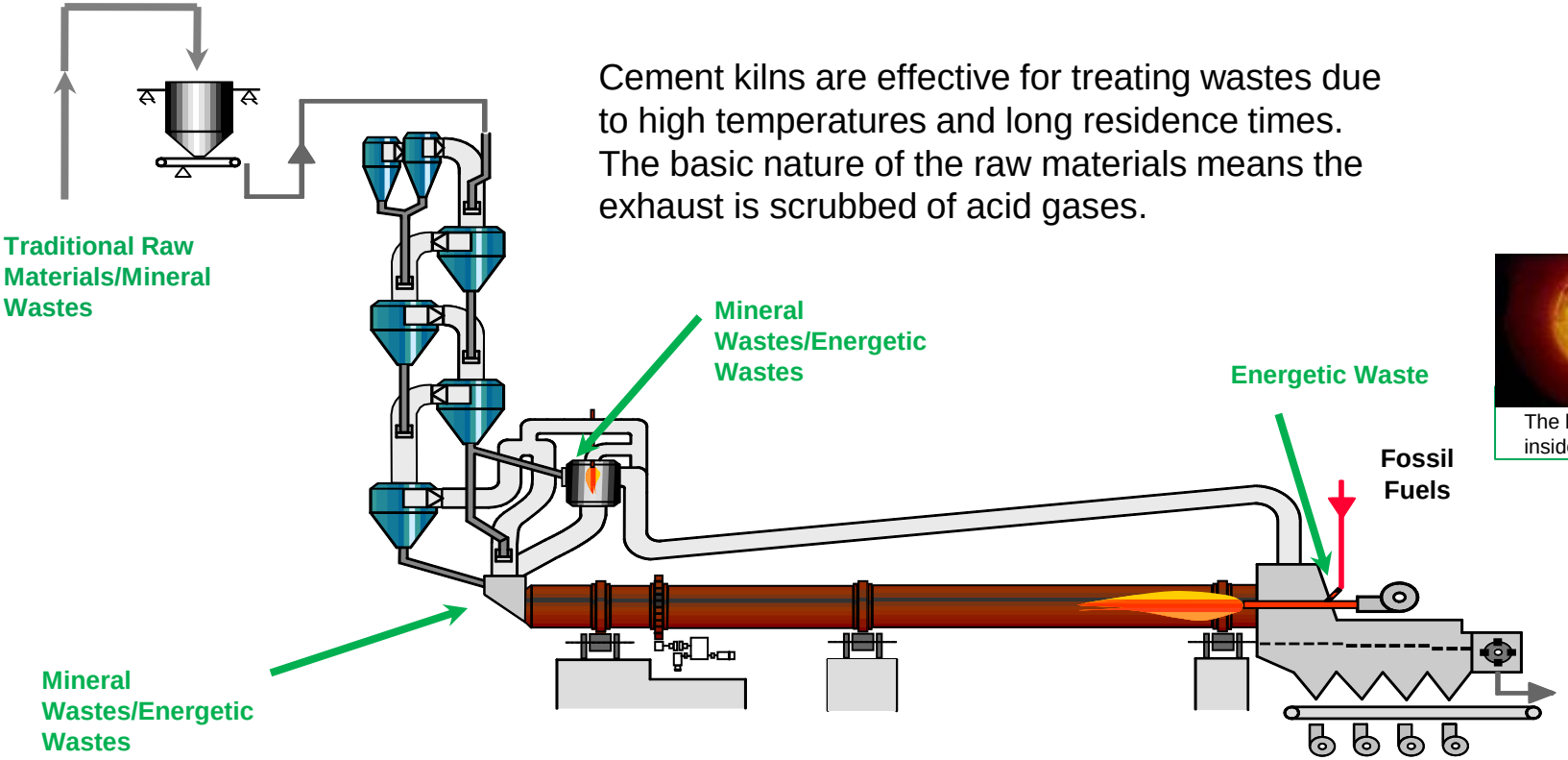
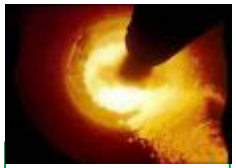
Cement kilns and waste treatment

Cement kilns are effective for treating wastes due to high temperatures and long residence times. The basic nature of the raw materials means the exhaust is scrubbed of acid gases.





The burning zone inside cement kiln

Mineral wastes are recycled in the kiln

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Oxides needed to make a standard Portland cement

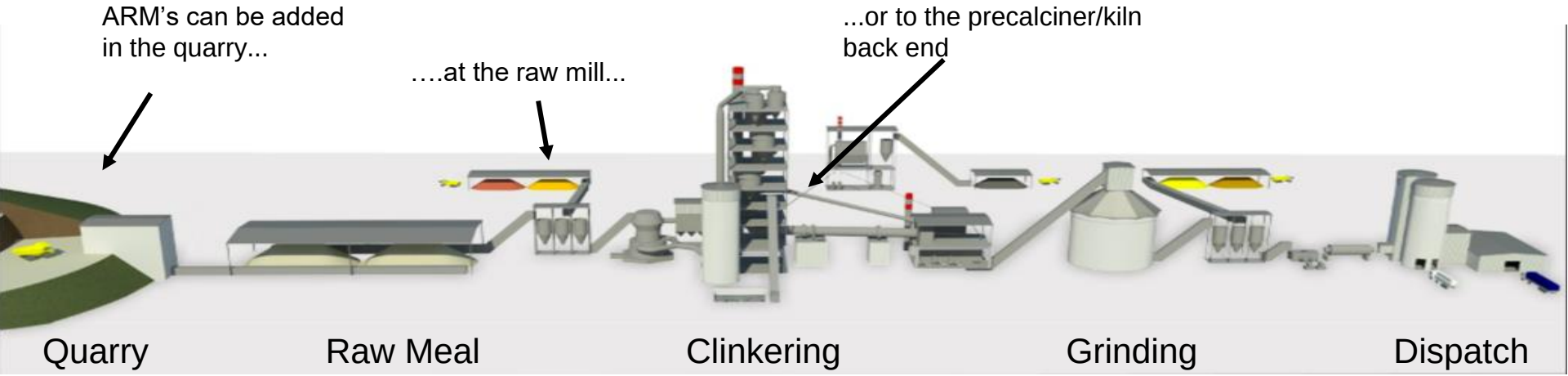
Major Oxide	% of clinker	Source (s)
CaO	63-69%	Limestone, Chalk
SiO2	20 – 24,5 %	Si Sand, ARM’s
Al2O3	3 – 6 %	Clay, shale, Bauxite, ARM’s
Fe2O3	0,3 – 5,5 %	Clay, Pyrite, Iron Ore, Tyres, ARM’s
MgO	0,5 - 4.5%	Dolomite
SO3	0 - 1.5%	Pyrite, Fuel
K2O	0.15 - 1.5%	Clay, Shale
Na2O	0 - 0.5%	

Exact Raw mix chemistry differs from plat to plant.

Some plants need only the naturally occurring raw materials

Others need to supplement the quarried materials with additional sources.

Where can ARM’s be added ?



- Adding materials in the quarry costs little but dosing is limited
- Adding material at the raw mill allows better control of the mix
- Materials are added at the hot part of the process (pre-calciner or kiln back end) if they have volatile contents which could impact if added earlier in the process.

Operational Impacts

Important factors to take into account when using ARM:

- How will the material be stored on site (fugitive dust, leachate, explosive/toxic gases) ?
- Will the use of the ARM lead to a change in the way the quarry is operated ?
- Where should the ARM be added ?
- What is the material grindability, will it impact raw mill capacity
- How can quality control be maintained
- Are there minor elements that may impact the product quality (Cr P2O5, MgO, Mn etc), or plant emissions (VOC’s HM’s etc)

Overview of ARM in LH today

4 key Pillars of ARM development

Basic Components : Si - Fe - Al - Ca

- Traditional ARM activity aims at replacing basic components of the raw mix)

Niche wastes

- Spent Pot Liner
- Polluted soils
- Mineralized Clinker Alkali additions

Construction & Demolition Waste

- Increasing circularity within the construction sector
- High volume, diverse waste stream, with high substitution potential

Historical landfills / stocks

- Red muds, slags, ashes, sometime in huge quantities but may have traces contaminants (Cr, Pb, Hg, Cd …) which can require **preliminary pre-treatment facilties**

5.4 Miot/yr > 30 streams

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Examples of ARM's used in LH plants

Material	Segment	Description	Source	Typical chemistry	Usage	Comment
Foundry sand	Basic Component	Waste Sand used as mould casings	Metal castings, particularly from automotive industry	~ 95% SiO_2,	N America, Asia, Europe	Can contain phenols
Mill Scale	Basic Component	Solid residues from rolling of steel	Steel tube production	Fe_2O_3 up to 75%	N America, Europe, Asia, Lat America, Middle East Africa	Usually contains VOC's (oil residues). Can have Cr content
Waste Bricks	CDW	Clay bricks	Demolition sites	Variable composition mainly Al_2O_3 and SiO_2	Europe > 200kt/yr in 2 Austrian plants	Pre-requisite: Sorting of CDW
Steel Slags	Basic Component	BOF slags, EAF Slags, Ladle slags	Steel Production Basic Oxygen or Electric Arc processes	CaO 25 - 50% Can have high Fe_2O_3(10 - 30%)	Europe, N America	May contain high levels of Cr. Can be hard to grind
Spent Pot Liners	Niche wastes	Mix of waste refractory bricks and carbon	Primary Aluminum smelting	Approx 20% Al_2O_3, Up to 50% SiO_2 High F and alkali content.	Europe, Middle East Africa	Production of explosive or toxic gas in contact with water

Examples of ARM's used in LH plants (2)

Material	Segment	Description	Source	Typical chemistry	Usage	Comment
Polluted soils	Niche	Excavation soils	Brownfield construction. Environmental clean up.	Major oxide content is variable but contains Si and Ca.	Europe, N America, Africa	VOC content may require direct injection to kiln.
Concrete fines	CDW	Residue after sorting of CDW	Demolition sites	Highly variable contains all basic oxides for cement (Si,Al, Fe, Ca)	Europe	Potential for very high usage rates (up to 40%)
Coal Ash	Historic Stocks	Ash from burning of Lignite (poor quality calcareous coal often called Brown coal.	Power stations fresh production and historic stocks.	CaO content variable 5-45% (avg 20%). Can also contain significant Al and Si.	Non Haz Can contain unburned Carbon	Can contain unburned carbon
Red Mud	Historic Stocks	Residue from first stage of Aluminium prodn	Processing of bauxite	High Fe2O3 content	Asia/Europe	Can contain Cr or other metals

Other materials include: copper slag, spent catalysts, alumina dross, paper ash, biomass ash, glass wastes, off spec lime, waste roof tiles, egg shells, mining wastes, silt and dredging wastes, excavation and tunneling wastes, waste limestone, waste plasterboard….

Conclusions

- The cement making process provides an effective treatment for many waste materials
- The co-processing of mineral wastes as ARM’s permits the recycling of these residues into new products
- A very wide range of materials can be co-processed in cement kilns, usage rates depend on materials chemistry and the cement plants specific raw mix
- Injection points, dosing and control systems have to be carefully considered so as not to compromise product quality or impact emissions


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