Breaking the paradigm of ‘developing country’
Challenges and opportunities of the African Cement Industry

Globalization
- Faster information sharing
- Standardization

Growth
- Capturing opportunity window
- Financial risks / ROIC
- CAPEX / Flexibility

Applications
- Segmenting the market
- Adapting prod. performance
- Differentiation

Production
- SCM availability & drawbacks
- Clinker Factor / CO2
- Grinding capacity

Efficiency

Logistics
- Reliable distribution
- Safety issues
- Electricity & water supply
Keeping pace with the growth rate...

**Increasing population, urbanization trend**
- 1 billion people (+50% in 2030)
- 52 cities above 1 million
- Multiple languages, dialects, religious beliefs

**Increasing economic performance**
- GDP average growth >5% (several, e.g. Ghana, Ethiopia >8%)
- More middle-class households than India, growth:16% p.a.
- FDI inflow increase 10-fold over the last 10 years

...but
...growth is not for ever....
And growth may implicate some risks, too.

When to invest?
Where to invest?
How much to invest?

→ Flexibility is needed!

Cement Additives, while extending capacity, can contribute to delay investments and so to mitigate financial risks

→ Improvement of RONO/A, ROIC
New business models have to be considered…
Example ‘Plug & Grind’ by Cemengal
Performance monitoring of a Grinding Aid in BASF pilot mill: reduction of specific energy (kWh/t)
Validation of results in industrial mill trials in a cement plant: increase of production capacity (t/h)

- Reference grinding aid: CEMENTIUM “A”
- Mill Feed increase

CEMENTIUM “B”
Improvement of granulometry (narrower laser PSD)
Example: industrial tests in a Ball Mill

Laser Granulometry – Cumulative Distribution

Laser Granulometry – Frequency Distribution
Mechanism of action of Grinding Aids

**Ball Mills**

- Particle dispersion: avoiding ball coating, increasing separator efficiency

**Vertical Roller Mills**

- A) Compaction on table, **and** B) Dispersion in separator
- More challenging application
- In general, still less performance of cement additives than in BM
- Water injection is used (vibrations)
CEMENTIUM Case Study
160 tph Vertical Roller Mill in West Africa

- Ongoing industrial tests on-site with new CEMENTIUM 2121 ES
- Relevant improvement of **grinding efficiency** achieved
  → Energy cost saving / increase of production capacity by 16 tph
- ~30% **less dosage** than common additives
  → reduced logistics & storage required
Typical application segmentation of an African cement market

- Infrastructure / projects
- Precast producers / block manufacturers
- Ready-mix producers
- Housing: ‘Formal’ and ‘Informal’ construction (bag)
Knowing applications requirements is fundamental for differentiation & positioning.

- ‘Informal’ construction
- Ready-mix producers
- Precast / Block producers
- Infrastructure, Projects

- Workability
- Setting time
- Branding!
- 28d-strength
- Fulfill Standards
- No slump loss
- Early strength
- ‘Green’ strength
- Low stickiness
- Specifications, e.g. w/c ratio,
  Durability (S, Cl), low-heat
Also the ‘informal’ market can be further segmented into different applications:

- Infrastructure / projects
- Precast producers / block manufacturers
- Ready-mix producers

Housing: ‘Formal’ and ‘Informal’ construction (bag)

- Foundations: Low strength
- Brick laying: Workability, extended setting
- Slabs: Early strength
- Plastering: Adhesion, crack-free

Cement sales (qualitative)

100%

0%
Cement Additives are an important tool to adapt cement performance to customer’s needs.

- ‘Designing’ cement according to application requirements (optimization of performance and costs)
- Tailor-made solutions can be developed for a high variety of requirements

**CEMENTIUM® SERIES**

**Grinding aids**
- CEMENTIUM 1000 GA: Grinding aids

**Performance enhancers**
- CEMENTIUM 2000 ES: Early-strength enhancers
- CEMENTIUM 3000 LS: Late-strength enhancers
- CEMENTIUM 4000 SW: Strength and workability improvers
- CEMENTIUM 5000 AE: Air-entraining agents
- CEMENTIUM 6000 SP: Specialty products
The challenge
An independent cement producer was using a traditional early strength enhancer in its CEM II 42.5R cement. Due to the increasing pressure on plant optimization, he was seeking superior performance, but without cost increase.

BASF solution
• Assessing benchmark performance
• Developing the new Chloride-free Early Strength Enhancer CEMENTIUM 2102 ES
• Lab tests and industrial trials

Customer‘s benefits
• Higher performance: strength: +7% at 1d, +6% at 28d, mortar flow +5% vs. benchmark
• Much better pack-set: +18%
• Keeping the same cost per ton cement

„….I gave BASF the task to work on performance increase, but I made it clear from the beginning that I was not ready to assume higher cost per ton cement.”

The company owner
Example:
CEMENTIUM 5000 AE for masonry cement

Indicated for cements / binders with high filler content and very low Clinker Factor

Tailor-made approach to fulfill specific needs:

- Rheology
- Adhesion
- Water retention
- Setting time
- Mechanical (low) strength
- Mill productivity (Grinding Aid action)
- Coloring

→ Attention: low-strength cements implicate risks of misuse in structures!
Latests innovation: Cement Tracer

Background

- Deficiencies in construction threaten life
- Cement producers may bear liability risks
- Difficult to track cement origin and provide evidence in case of damages

→ So far, there is no reliable method to determine cement content in concrete, particularly in case of use of composite cements. Standards cannot be verified!

→ ‘Coding’ cements. High number of color combinations are possible. Colors are only visible with analytics (spectro-photometry).
**Cement Tracer: Possible applications**

- **Cement production process**
  Cement tracing within cement plant in order to investigate flows, retention times, silo management, mixing efficiency, …

- **Cement distribution**
  Cement tracing to track distribution channels, imports, shippings, blending,….

- **Marketing**
  Tracing special cement and prove its application (e.g. ‘eco-cement’)

- **Cement application in concrete**
  Proving cement type or supplier used in concrete (qualitative). Possibility to assess cement content in concrete (e.g. to fulfill Standards or specifications)

Dosing on clinker mill feed

Analysis of cement or concrete
BASF analytical capabilities: quantitative clinker & cement analysis

Mineralogists / Crystallographers with more than 30 years of experience in Rietveld refinement of cements

- Quantification of clinker / cement phases
- Quantification of supplementary materials in binders (e.g. amorphous slag, Round Robin VDZ, 2008)
- Crystallographic parameters, site occupancy factors, crystallite size
- QXRD in hydrating systems, degree of hydration, crystallography of hydrates
BASF Construction Chemicals
R&D Centre, Trostberg, Germany
Modeling the grinding process for implementation of Cement Additives

Addition in mortar water | Lab jar mill | Heated lab mill | Real plant

- Chemical reaction ✓ ✓ ✓ ✓
- Comminution effect ✓ ✓ ✓ ✓
- Temperature control ✓ ✓ ✓ ✓
- Gas phase simulation ✓ ✓ ✓ ✓
- Particle Size Distribution ✓ ✓ ✓ ✓
- Technical KPI comparison ✓ ✓ ✓ ✓

“big step”
Modeling a grinding process for implementation of cement additives

- Addition in mortar water
- Lab jar mill
- Heated lab mill
- Pilot mill
- Real plant

- Chemical reaction
- Comminution effect
- Temperature control
- Gas phase simulation
- Particle Size Distribution
- Technical KPI comparison

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New equipment for additives development: The BASF pilot mill located in Treviso, Italy
New equipment for additives development: The BASF pilot mill located in Treviso, Italy

Technical data:
- 1:10-scale grinding plant in a dedicated building
- Closed circuits, two-chamber ball mill
- Dynamic separator
- Mill temperature regulation
- Airflow rate regulation
- Mill performance evaluation and automatic feed control by noise measurement
- PLC in a separate, noise-isolated control room
Availability of SCMs in Africa
(main constituents for composite cement only*)

GBSF (Granulated Blast Furnace Slag)
Possible slag imports

Fly Ash (from coal-fired power plants)

Natural pozzolan (major deposits)
Limestone is widely available (wherever clinker is produced)

*Does not include minor constituents (e.g. silica fume) or alternative raw meal materials (e.g. steel slag), or materials requiring calcination (e.g. calcinated clays)
Differentiation opportunities by integration of SCMs in cement and role of Cement Additives

- Blast furnace slag
  - Late strength
  - Durability
  - Early strength
  - Grinding en.
  - ES Enhancers

- Fly Ash
  - Workability
  - Durability
  - Early strength
  - Quality
  - ES+LS Enhancers

- Natural Pozzolan
  - Low cost / avail.
  - (Diverse)
  - Strength
  - Water demand
  - ES+ES+SW

- Limestone
  - Low cost / avail.
  - Workability
  - Late strength
  - LS Enhancers
Attractive opportunities to use pozzolans in the Rift Valley

Cement Additives can mitigate strength loss and water demand in puzzolanic cements (e.g. CEMENTIUM 4000 SW)
The challenge
Increasing cost pressure on cement manufacturers has forced them to seek ways to reduce their clinker factor. A well-known cement manufacturer in Turkey asked for a tailor-made additive that would enable them to increase SCM content in their CEM II A 42,5 R.

BASF solution
• Development of the tailor-made CEMENTIUM 3102 LS
• Beside late strength enhancement, working on improving concrete properties
• Lab and on-site tests

Customer’s benefits
• Reduced 3% pts. of clinker in CEM II A 42,5
• Added value to cement users, thanks to improved concrete rheological properties

“BASF has proved itself to be a valid solution partner by responding to our specific request, and meeting it with our full satisfaction…”
Production Manager
Distribution issues of African markets. Importance to have a reliable partner

- Long distribution distances, especially if products are sourced from Europe
- Availability of port / jetty
- Handling facilities at ports
- Storage / warehouses in the country
- Infrastructure network (road, rail, water)
- Bureaucracy, paperwork
- Piracy, robberies
- Safety
BASF locations and supply footprint for Cement Additives

- **Preferred supply route**
- **Local action radius**
- **Considered location of new plants**

- Existing BASF Construction Chemicals production sites

Map showing BASF locations and supply footprint for Cement Additives, with markers for Germany, Italy, and Turkey.
# Conclusions

## Challenges of Cement Industry

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<th>Market demand growth</th>
<th>• CAPEX / risks</th>
<th>• Missed opportunities</th>
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## Implications / Opportunities

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<th>• Differentiation</th>
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<th>Logistics</th>
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CEMENTIUM®
Cementing a better future.

The Chemical Company
BASF – The Chemical Company

- Our chemicals are used in almost all industries
- We combine economic success, social responsibility and environmental protection.
- Sales 2011: €73,497 million
- EBIT 2011: €8,586 million
- Employees (as of December 31, 2011): 111,141
- In 2011, BASF filed for around 1,050 new patents worldwide
- 6 integrated plants (‘Verbund‘) and around 370 production sites
Production Site in Ludwigshafen, Germany: World’s largest integrated chemical complex

- 10 km² surface
- 200 production plants
- 2,000 km pipelines
- 33,000 employees
CEMENTIUM®
Cementing a better future.