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BLENDED CEMENTS – THE TCI PERSPECTIVE

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LC3 Workshop

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Introduction

- Prior to 1996 South Africa had a limited range of cements
  - OPC
  - RHC
  - PC15SL/FA
  - PC30
  - PBFC

Blended Cements in South Africa

- South Africa has used SCMs for a long time.
- GGBS was introduced in the early 1960s
- Fly ash in the late 1980’s

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Blended Cements in South Africa

- South Africa adopted EN 197 (SANS 50197) in 1996
- Adopted EN standards SANS 50450, SANS 55167 and SANS 53263 for extenders a few years ago

Table 1.1: Common cements: SABS EN 197-1

Main types	Notation of products (types of common cement)		Composition, percentage by mass[(a)]										
			Clinker	Blast-furnace slag	Silica fume	Pozzolana		Fly ash		Burnt shale	Limestone		Minor additional constituents
						natural	natural calcined	siliceous	calcareous				
			K	S	D[(b)]	P	Q	V	W	T	L	LL	
CEM I	Portland cement	CEM I	95 - 100	-	-	-	-	-	-	-	-	-	0 - 5
CEM II	Portland-slag cement	CEM II A-S	80 - 94	6 - 20	-	-	-	-	-	-	-	-	0 - 5
		CEM II B-S	65 - 79	21 - 35	-	-	-	-	-	-	-	-	0 - 5
	Portland-silica fume cement	CEM II A-D	90 - 94	-	6 - 10	-	-	-	-	-	-	-	0 - 5
	Portland-pozzolana cement	CEM II A-P	80 - 94	-	-	6 - 20	-	-	-	-	-	-	0 - 5
		CEM II B-P	65 - 79	-	-	21 - 35	-	-	-	-	-	-	0 - 5
		CEM II A-Q	80 - 94	-	-	-	6 - 20	-	-	-	-	-	0 - 5
		CEM II B-Q	65 - 79	-	-	-	21 - 35	-	-	-	-	-	0 - 5
	Portland-fly ash cement	CEM II A-V	80 - 94	-	-	-	-	6 - 20	-	-	-	-	0 - 5
		CEM II B-V	65 - 79	-	-	-	-	21 - 35	-	-	-	-	0 - 5
		CEM II A-W	80 - 94	-	-	-	-	-	6 - 20	-	-	-	0 - 5
		CEM II B-W	65 - 79	-	-	-	-	-	21 - 35	-	-	-	0 - 5
	Portland-burnt shale cement	CEM II A-T	80 - 94	-	-	-	-	-	-	6 - 20	-	-	0 - 5
		CEM II B-T	65 - 79	-	-	-	-	-	-	21 - 35	-	-	0 - 5
	Portland-limestone cement	CEM II A-L	80 - 94	-	-	-	-	-	-	-	6 - 20	-	0 - 5
		CEM II B-L	65 - 79	-	-	-	-	-	-	-	21 - 35	-	0 - 5
		CEM II A-LL	80 - 94	-	-	-	-	-	-	-	-	6 - 20	0 - 5
		CEM II B-LL	65 - 79	-	-	-	-	-	-	-	-	21 - 35	0 - 5
	Portland-composite cement[(c)]	CEM II A-M	80 - 94	◄------				6 - 20				------►	0 - 5
		CEM II B-M	65 - 79	◄------				21 - 35				------►	0 - 5
CEM III	Blastfurnace cement	CEM III A	35 - 64	36 - 65	-	-	-	-	-	-	-	-	0 - 5
		CEM III B	20 - 34	66 - 80	-	-	-	-	-	-	-	-	0 - 5
		CEM III C	5 - 19	81 - 95	-	-	-	-	-	-	-	-	0 - 5
CEM IV	Pozzolanic cement[(c)]	CEM IV A	65 - 89	-	◄------		11 - 35		------►	-	-	-	0 - 5
		CEM IV B	45 - 64	-	◄------		36 - 55		------►	-	-	-	0 - 5
CEM V	Composite cement[(c)]	CEM V A	40 - 64	18 - 30	-	◄---	18 - 30	---►	-	-	-	-	0 - 5
		CEM V B	20 - 39	31 - 50	-	◄---	31 - 50	---►	-	-	-	-	0 - 5

Notes

(a) The values in the table refer to the sum of the main and minor additional constituents.

(b) The proportion of silica fume is limited to 10%.

(c) In portland-composite cements CEM II A - M and CEM II B - M, in pozzolanic cements CEM IV A and CEM IV B, and in composite cements CEM V A and CEM V B the main constituents other than clinker shall be declared by designation of the cement.

Availability of extenders

- GGBS available in Vanderbijlpark and Newcastle
- GGCS available from Saldahna?????
- Fly ash from a number of power stations primarily in Mpumulanga and Free State
- Silica fume in Gauteng and Limpopo
- Poor geographic spread

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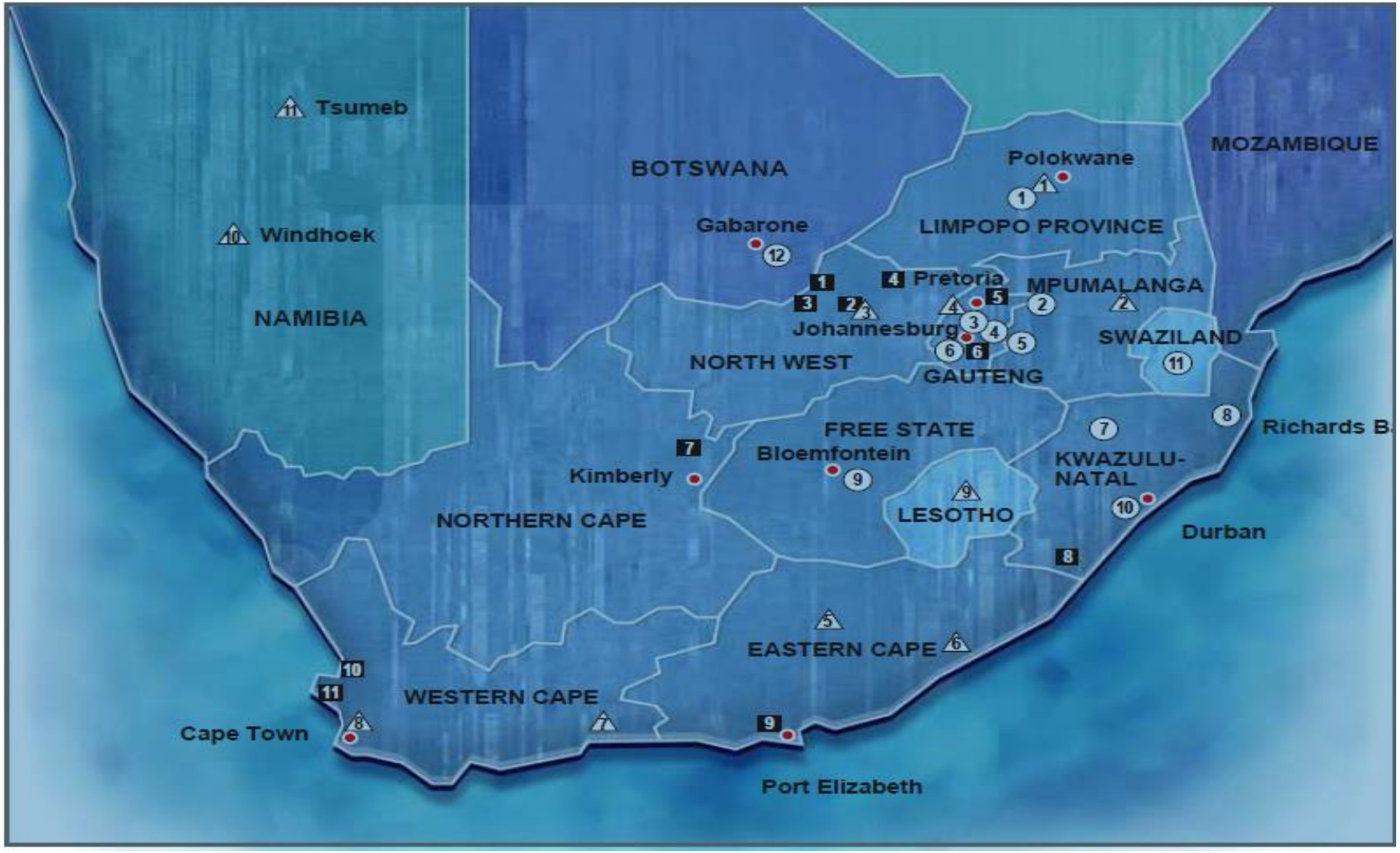

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Role and Benefits of SCMs

- Cost
- Role in improving durability
- Role in reducing CO2 emissions
- Role in reducing dumps

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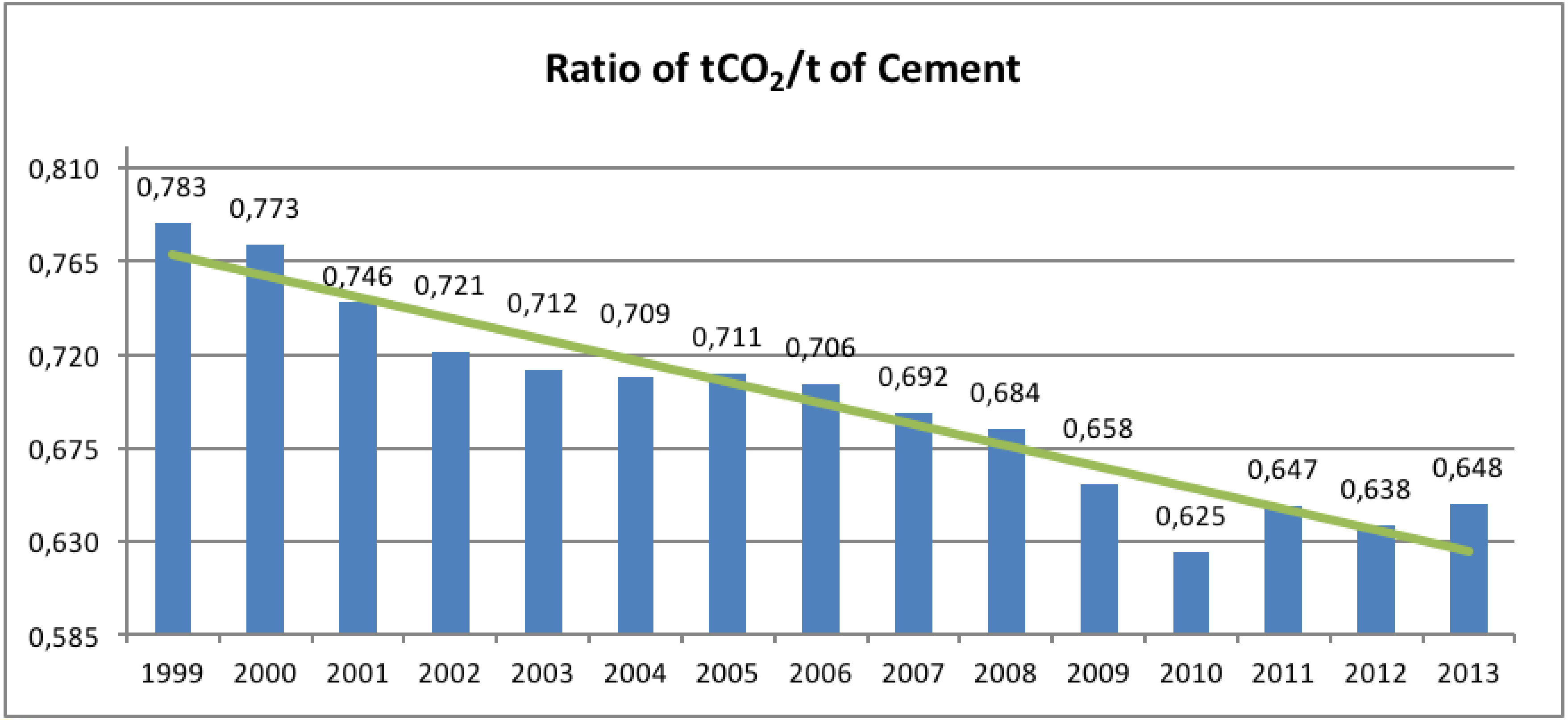
Cost benefits

- GGBS, GGCS, fly ash and limestone cheaper than cement

Durability Benefits

- Reduction in thermal cracking and heat of hydration
- Prevention or reduced risk of ASR
- Good for chloride capture or reduced chloride attack
- Reduced permeability preventing aggressive agent ingress
- Improvement in sulphate resistance

Role in Reducing CO_2 Emissions



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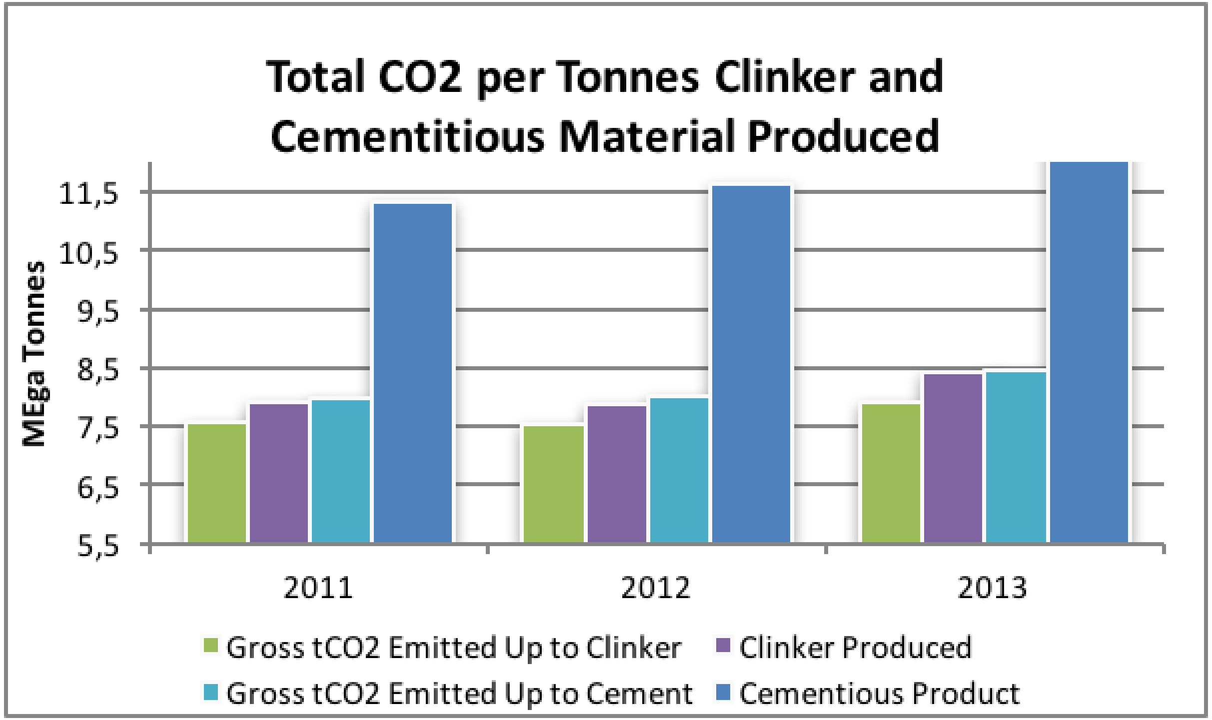
Total CO2 per Tonnes Clinker and Cementitious Material Produced
MEga Tonnes
11,5
10,5
9,5
8,5
7,5
6,5
5,5
2011
2012
2013
Gross tCO2 Emitted Up to Clinker
Clinker Produced
Gross tCO2 Emitted Up to Cement
Cementious Product

Cement Type	Average Emission Values (kg CO_2e/ton)
CEM I	985
CEM II A-L	840
CEM II A-S	815
CEM II A-V	790
CEM II B-L	720
CEM II B-S	730
CEM II B-V	690
CEM III A	560
CEM IV A	640
CEM IV B	570
CEM V A	590
CEM V B	415

Extender Type	Average Emission Values ($kg\ CO_2e/ton$)
Fly Ash	2
GGBS	130

Material	Average Emission Values ($kg\ CO_2e/ton$)
Aggregates	2
Admixtures	220
Water	1

Reducing dumps

- >50 million tons of ash with 10% utilisation

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Challenges

- Poor geographic spread
- Lack of SCMs in coastal areas

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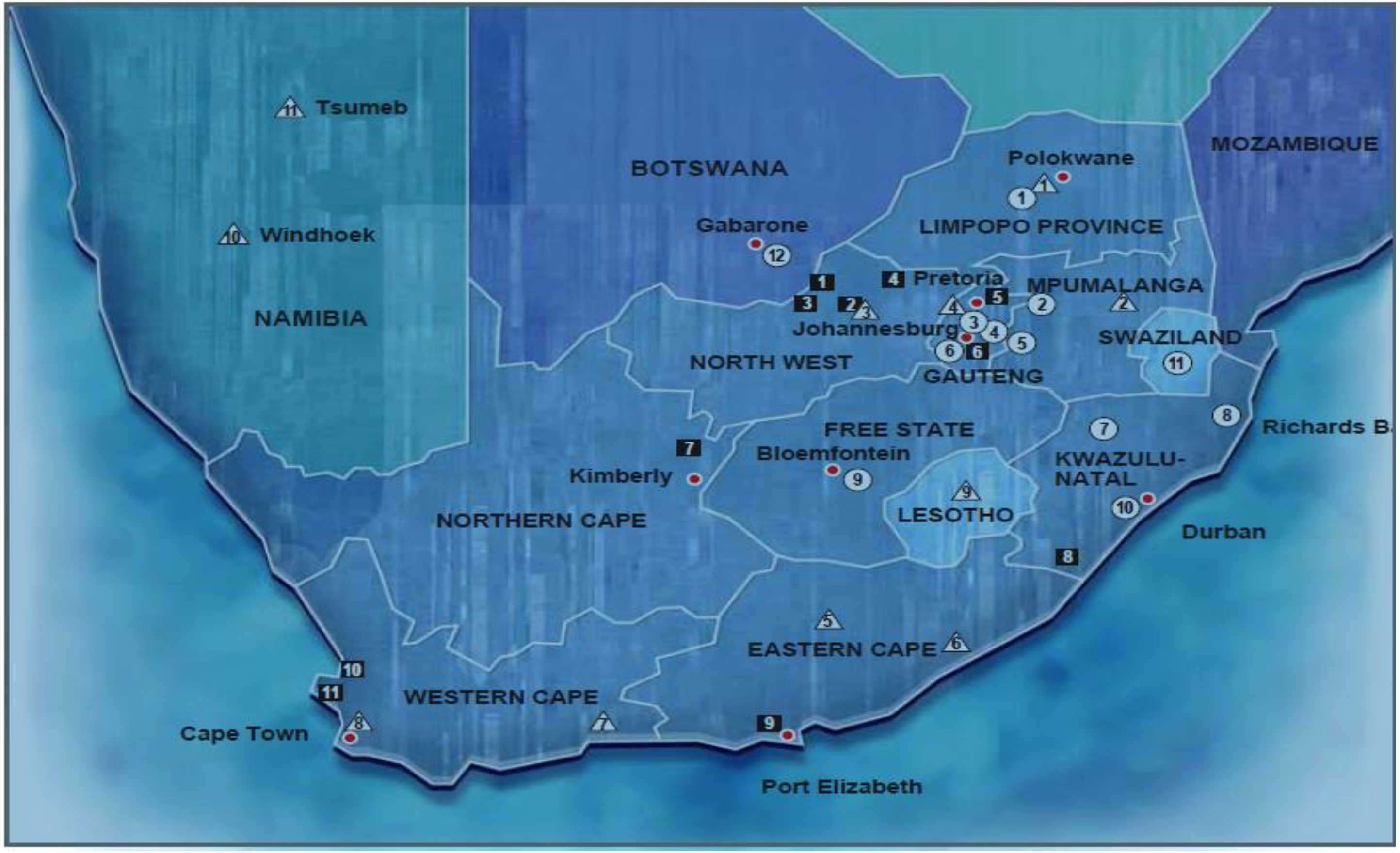
Tsumeb
Windhoek
NAMIBIA
BOTSWANA
Gabarone
Polokwane
LIMPOPO PROVINCE
MOZAMBIQUE
Pretoria
MPUMALANGA
Johannesburg
NORTH WEST
GAUTENG
SWAZILAND
FREE STATE
Bloemfontein
Kimberly
Richards B
KWAZULU-
NATAL
LESOTHO
Durban
NORTHERN CAPE
EASTERN CAPE
WESTERN CAPE
Cape Town
Port Elizabeth

Challenges

- Poor geographic spread
- Lack of extenders in coastal areas
- Access to SCMs
- Inappropriate use of heavily extended cements due to lack of knowledge and understanding
- Quality of some blended products

Conclusions

- Extensive history of use
- Large number of benefits both in durability and sustainability
- There are challenges
- Blended cements are here to stay

Thank you

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