

Low CO₂ Fly Ash Concretes

David Cooney F.I.C.T
Development Manager
UNIBETON

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2007 fly ash trials - conclusions

Extensive tests demonstrate fly ash concretes have excellent fresh and hardened properties

Test results under all forms of measurement (workability, heat of hydration, strength, durability) indicate equivalent or superior to high performance Portland and blended GGBS concretes at similar cost

Quality assured Fly Ash recommended

2007 fly ash trials - conclusions

Admixture methodology important to maximize performance however normal type D and type F admixtures can produce excellent results

Later age (>28 day) testing permits users to take advantage of the superior strength gain and lower CO₂

Supplementary cement concretes set more slowly and good curing is essential to maximize benefits

Fresh properties

- Water demand

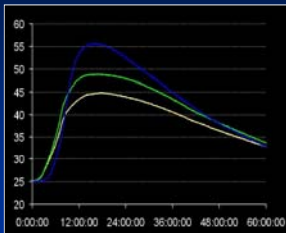
Water reduced in all Fly Ash groups to 13-15% of concrete volume, with ≈ 0.3 WC ratio for slump >225mm

- Slump retention

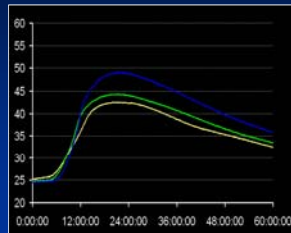
Fly ash trial group *	Slump, percent of initial slump minutes after completion of mixing				
	5 mins.	20	35	50	65
25% group average result	100	100	98	93	79
32.5% group average result	100	100	96	90	83
40% group average result	100	100	97	84	73

Heat of Hydration tests on various binders

(350kg, 425kg and 500kg)



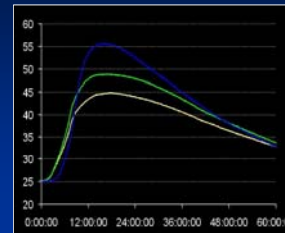
Portland group



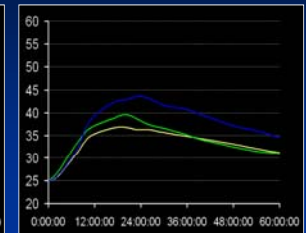
Fly Ash group 25%

Heat of Hydration tests on various binders

(350kg, 425kg and 500kg)

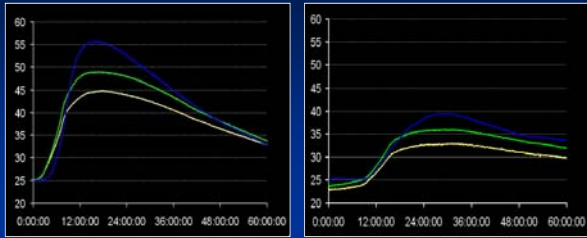


Portland group



Fly Ash group 40%

Heat of Hydration tests on various binders (350kg, 425kg and 500kg)



Portland group

Fly Ash group 55%

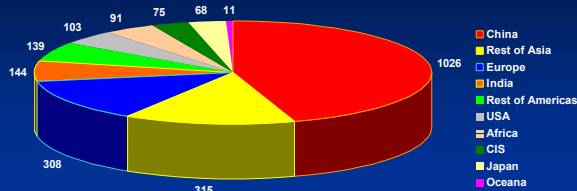
Phase 2 trials - initial results

C60 design test results at various replacement levels

Compression strength MPa (480kg total cementitious)				
Age	1 day	3	7	28
25% group average result	21	48	63	85
32.5% group average result	13	43	59	78
40% group average result	8	39	54	75

Durability group compression strength MPa (incorporating microsilica)				
Age	1 day	3	7	28
25% Fly Ash, 520kg, 6% MS	20	52	75	114
40% Fly Ash, 500kg, 6% MS	16	44	65	97

Estimated Cement Consumption (MT'1000's) 2005



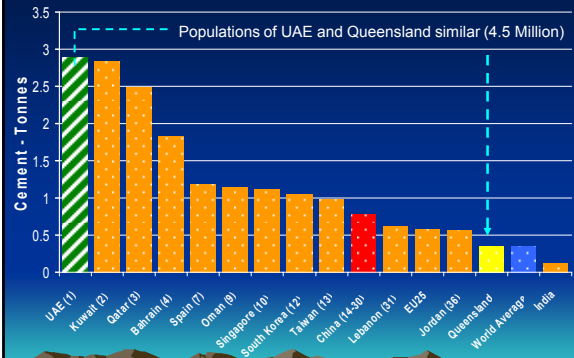
April 2008 - Media statement

"China becomes Number 1 producer of Greenhouse gases"

(est. 6.2 Billion Tonnes)

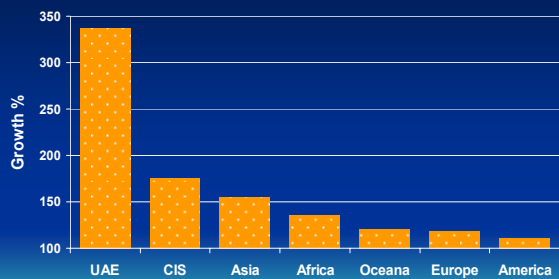
(16% from cement manufacturing?)

Cement consumption per capita, various States, Regions 2005



(World ranking in parenthesis)

Increase in cement consumption - percent 2000-2007, various regions



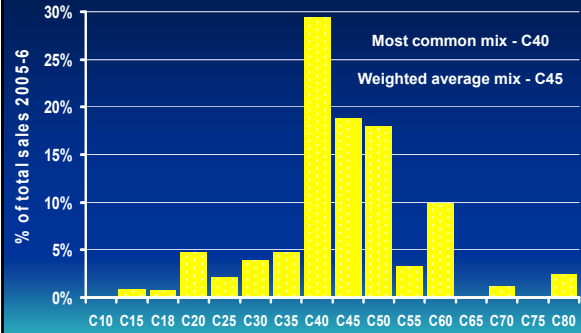
Future consumption trends, considerations

- World volume will increase from **2.283** billion tons in 2005 to **3.13** billion tons by 2015, and **3.56** billion tons five years later
- This represents an overall increase of **56%**
- 2005 Chinese market estimated at 45 percent of world consumption, with annual growth estimated at 8.5% (or 90 million metric tons per annum)
- Demand for cement in the UAE is expected to hit 26.2 million tonnes by 2011
- Large developments in Abu Dhabi (Yaas, Reem and Sadiyaat Islands) together with projects in other Emirates continue high demand for cement

Future consumption trends, considerations

- Increases in China, India, the Middle East and Africa will account for 85 per cent of the global demand for cement by 2020.
- They accounted for 75 per cent in 2005
- 2006 Chinese cement consumption accounted for 47 per cent of the world cement market, standing at 1.2 billion tonnes or 0.902 Tonnes per capita (say 3m² of concrete per capita)
- In 2006, India produced 145 million tonnes of cement or 0.126 Tonnes per capita (say 0.36m² of concrete per capita)
- UAE may produce >25 million tonnes of cement in 2008 or **5.41 Tonnes per capita** (say 14.24m² of concrete per capita)

Analysis of supplied concrete grades, 2005-6



Weighted average mix, (reference unit) and various nominally equivalent ECOSMART mixes (fly ash binder)

≈ 380kg test group	Portland cement	Supplementary cement	C. AGG	F. AGG	Admix	Water	Density	WC ratio
Portland (ref)	380	0	1085	746	4	170	2385	0.45
Fly Ash (10%)	340	40	1093	726	4	170	2368	0.43
Fly Ash (25%)	285	95	1095	724	4	165	2368	0.43
Fly Ash (40%)	230	154	1111	727	4	159	2385	0.41
Fly Ash (55%)	170	208	1115	720	4	147	2364	0.39

Fly Ash concretes - Potential savings compared to Portland concretes Annualized market demand of (say) 66 Million cubic metres in 2008

Main raw material requirements (Million tonnes)	Portland Group	10% Fly Ash group	25% Fly Ash group	40% Fly Ash group	55% Fly Ash group
Portland Cement	25	22.35	18.75	15.15	11.2
Fly Ash	0	2.65	6.25	10.15	13.7
Aggregates	120.5	119.7	119.7	120.95	120.75
Water	11.2	11.2	10.85	10.45	9.65
Total dry raw materials (Million tonnes)	145.5	144.7	144.7	146.25	145.65
Water saving (Million tonnes)	-	0	0.35	0.75	1.55
Additional standard road-hauled 70 Tonne trips	0	- 11430	- 11430	+10715	+2150

Fly Ash concretes - CO₂ and water savings compared to Portland concretes (annualized market demand of 66 Million cubic metres)

Main raw material requirements (Million tonnes)	Portland Group	10% Fly Ash group	25% Fly Ash group	40% Fly Ash group	55% Fly Ash group
Portland Cement	25	22.35	18.75	15.15	11.2
Fly Ash (1)	0	2.65	6.25	10.15	13.7
Aggregates	120.5	119.7	119.7	120.95	120.75
Water	11.2	11.2	10.85	10.45	9.65
CO ₂ saving from (1) (Million tonnes)	0	2.65	6.25	9.85	13.8
CO ₂ from fuel (2)	0	0.43	0.43	- 0.41	- 0.08
Net CO ₂ saving 1+ 2 (Million tonnes)	0	3.08	6.68	9.44	13.72
Water saving (Million tonnes)	-	0	0.35	0.75	1.55

Thank you!