Greener and stronger foundations

as a result of using GGBS cement

David O'Flynn doflynn@ecocem.ie 087 9654891

ECOCEM

Ecocem Ireland

ECOCEM

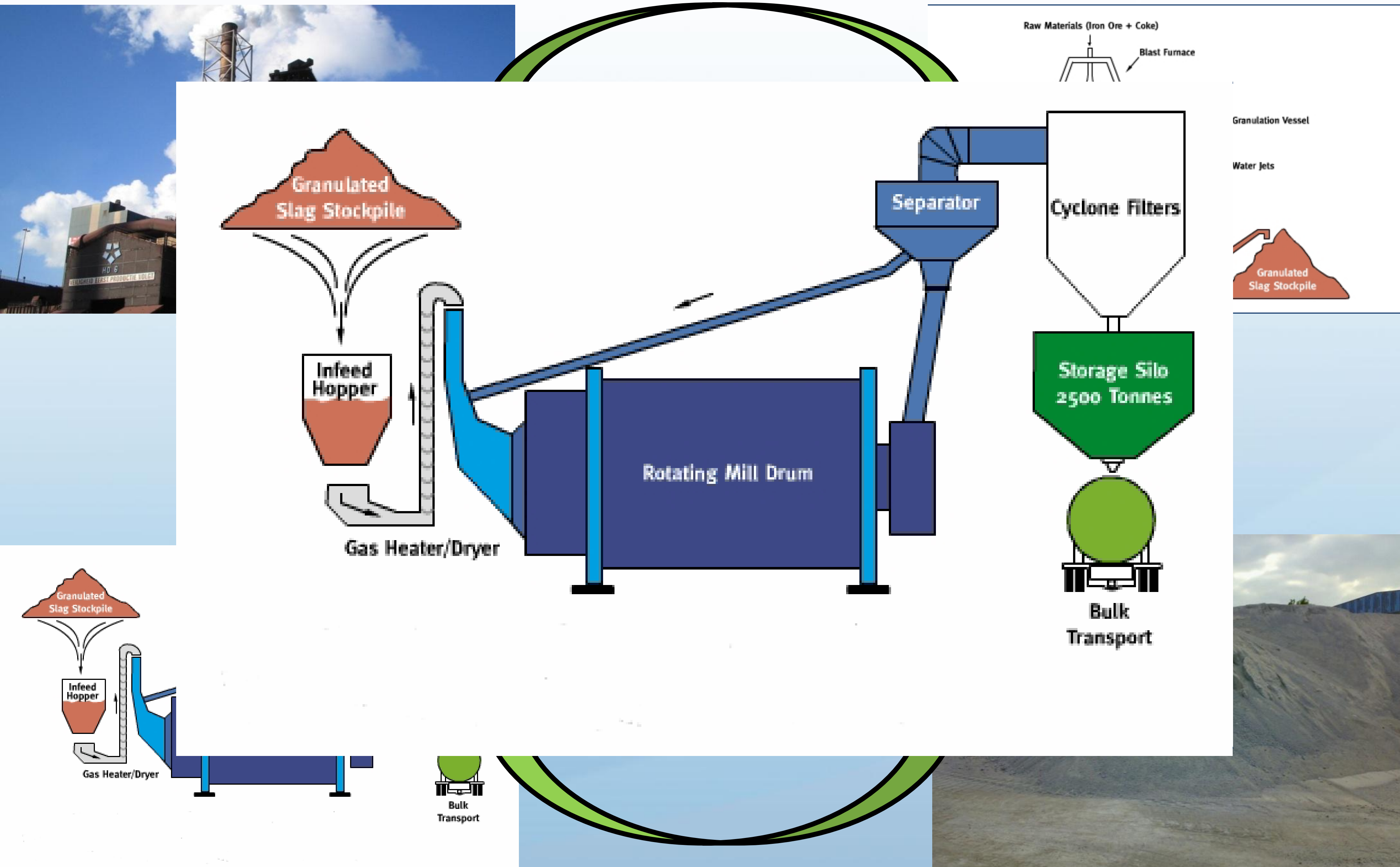
Brief History of GGBS

- 1862: Hydraulic potential of GGBS discovered in Germany
- Early 1900's - Portland Blast Furnace Cements had an established place in the concrete market

- 2004: More than 5,000,000 tonnes of GGBS produced in Germany
- 2006: Approximately 2,000,000 tonnes of GGBS produced in UK
- 2008: Over 400,000 tonnes available in Ireland

ECOCEM

GGBS Manufacture

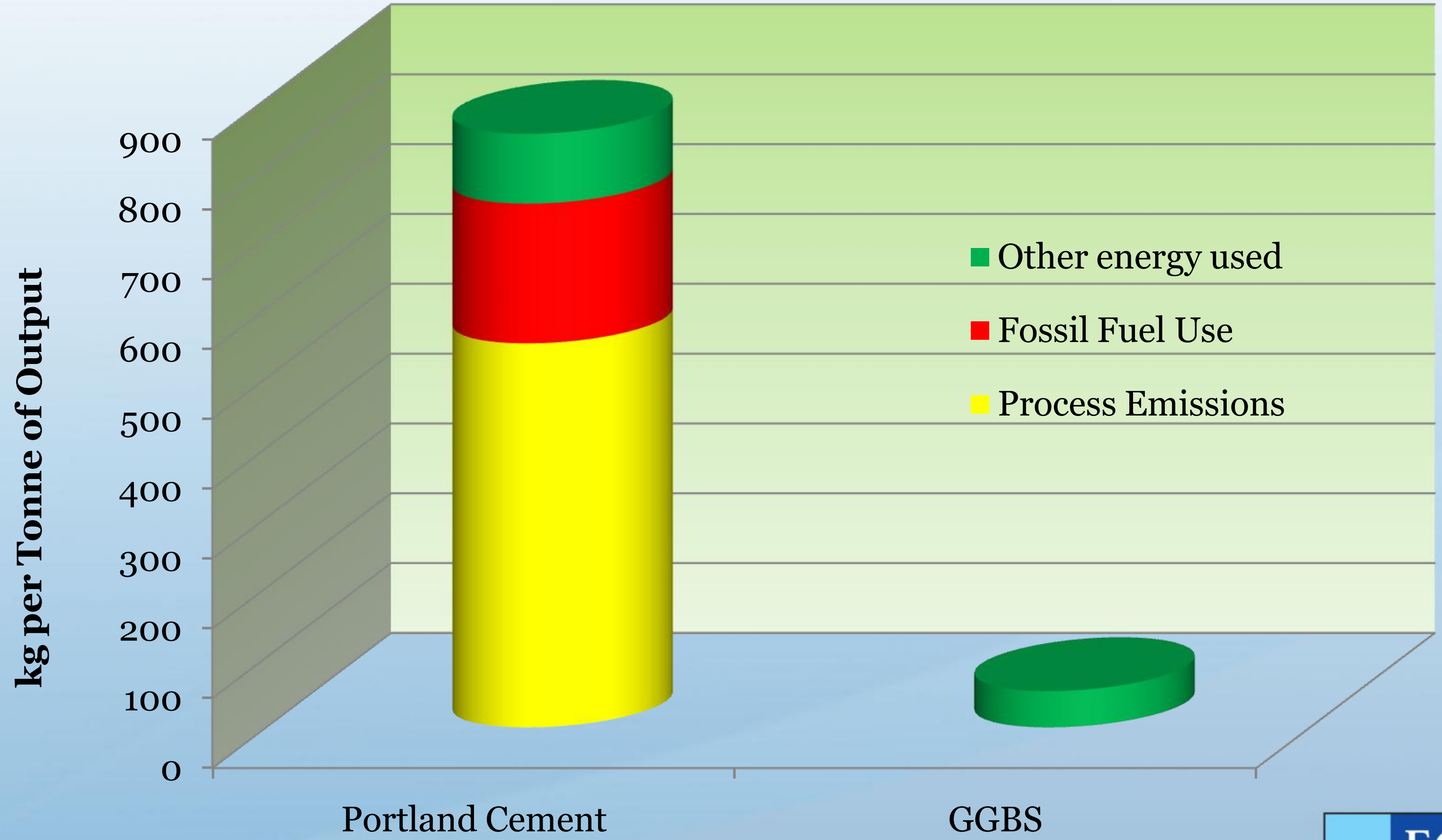


GGBS - Environment

GGBS - Environment

CO_2 emissions for GGBS and cement production

Typical CO2 Emissions for Portland Cement and GGBS Production
(Figures in kg per tonne of output)



ECOCEM

Environmental Savings

Environmental savings per typical base

		Equivalent
CO_2	79.4 tonnes	25 Cars or 10 acres of mature forestry/year
SO_2	245 kg	
NO_x	343 kg	
CO	245 kg	
PM_{10}	42.7 kg	
Energy	94,000 kwh	Power 18 homes for one year
Limestone/ Shale	160 tonnes	

www.ecocem.ie

low carbon concrete

Ecocem

Environmental Savings from using Low Carbon Concrete

Based on 400m3 of concrete with 350kg/m3 of cement with 70% of Ecocem cement

1. CO2 emissions saving:

79.4 tonnes of CO_2 saved
the same CO2 saving would require
taking 25.5 cars off the road for one year, or ... *
saving 25 years electricity in the average home *
the same amount of CO2 would be absorbed by
9.8 acres of managed Irish forest in one year

2. Harmful pollutants savings:

245 kg of SO_2 saved
343 kg of NOx saved
245 kg of CO saved
42.7 kg of PM10 saved

Sulphur dioxide, nitrous oxides and carbon monoxide all contribute to global warming, acidification and eutrophication, and along with PM10 are harmful to human health

3. Embodied energy of concrete savings:

338,712.5 MJ of energy saved
equal to the electrical energy used by
17.5 average homes in one year *

4. Depletion of natural resources savings:

159.3 tonnes of limestone and/or shale saved

ECOCEM

GGBS – Controlling thermal cracking

Controlling thermal cracking

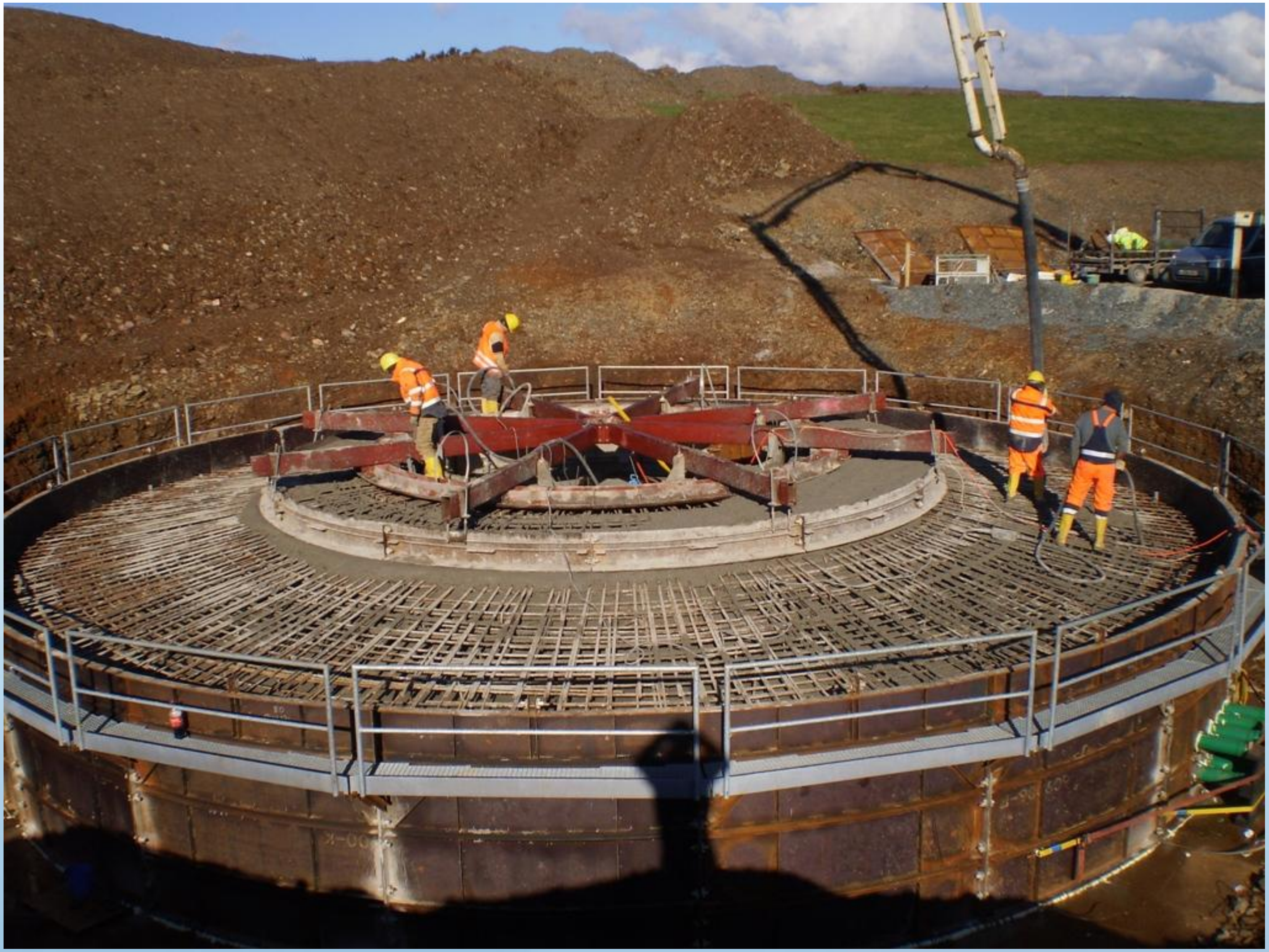


Image courtesy of Wind Farm Civils

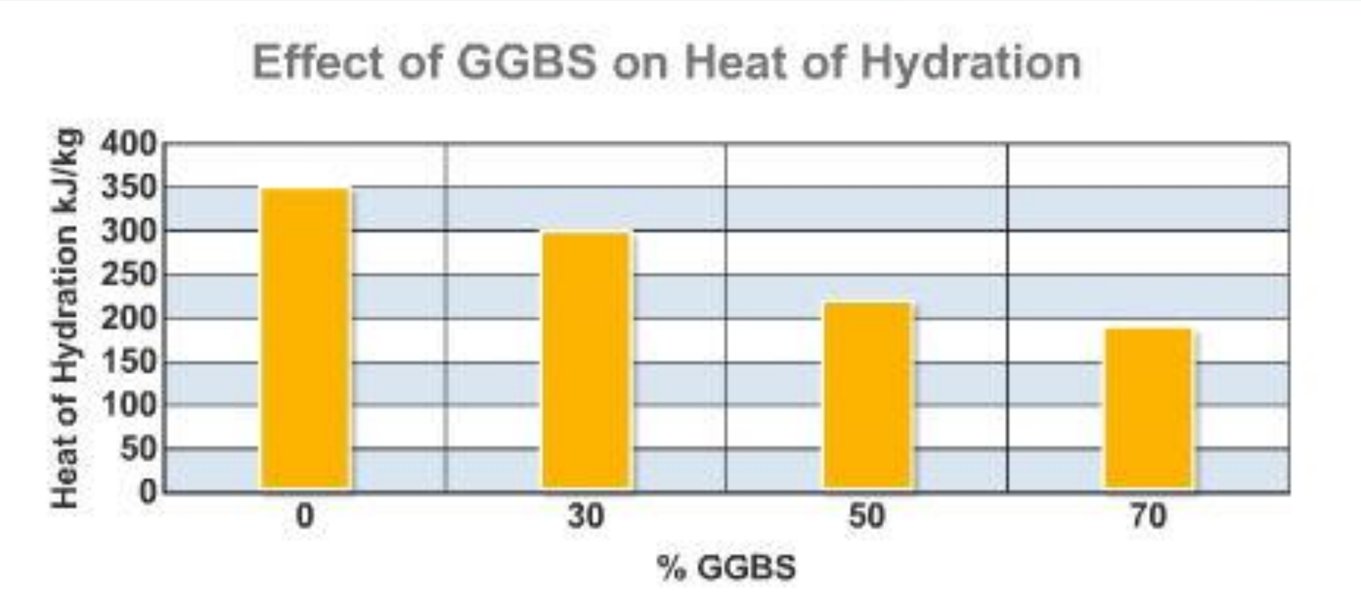
ECOCEM

Controlling thermal cracking

ECOCEM

Heat of Hydration

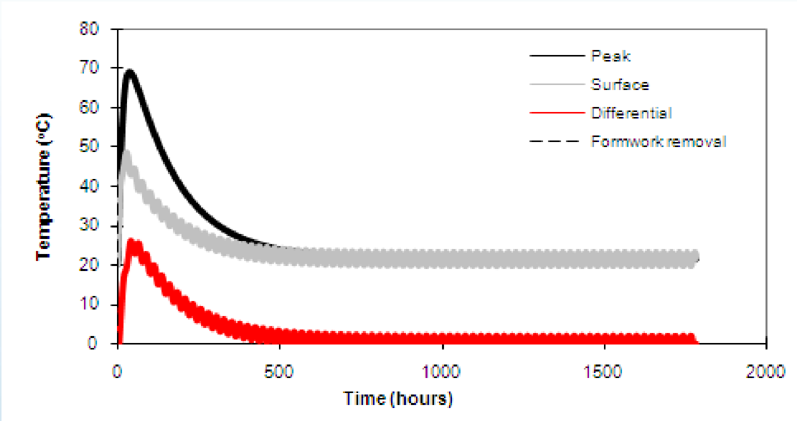
- GGBS lowers peak and overall heat
- Substitution level 70%



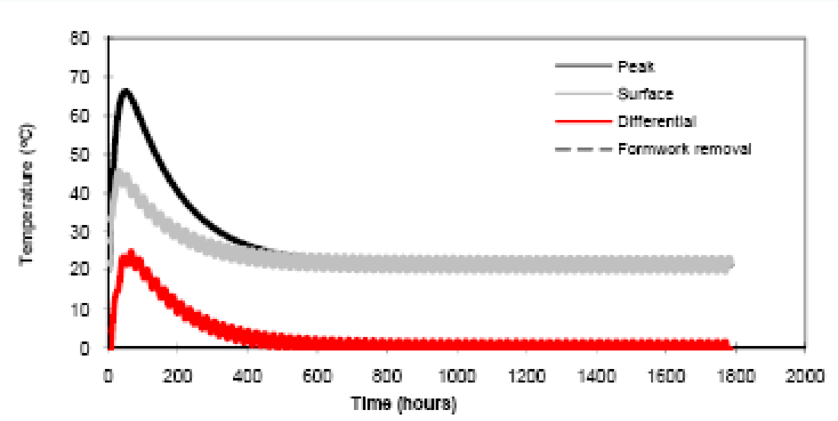
ECOCEM

Controlling thermal cracking

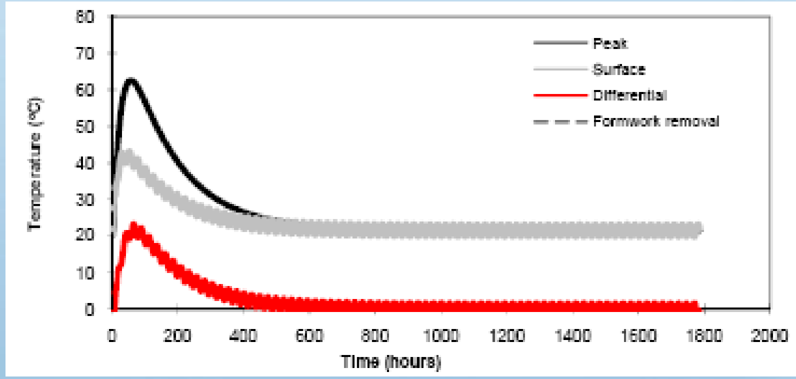
Maximum temperature differential on 1500mm deep base



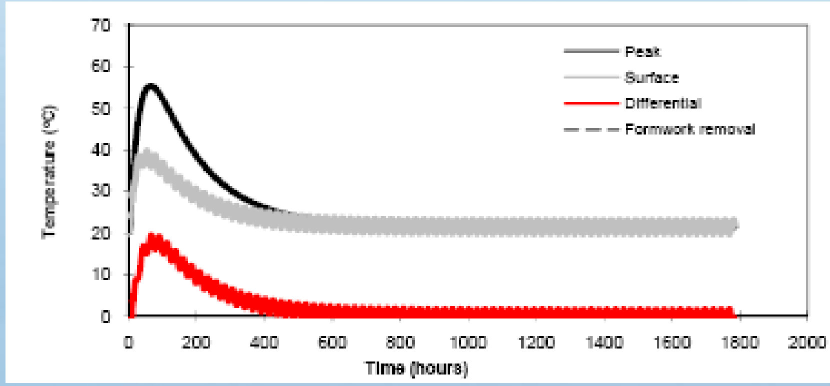
0% GGBS
26 degrees



30% GGBS
25 degrees



50% GGBS
23 degrees

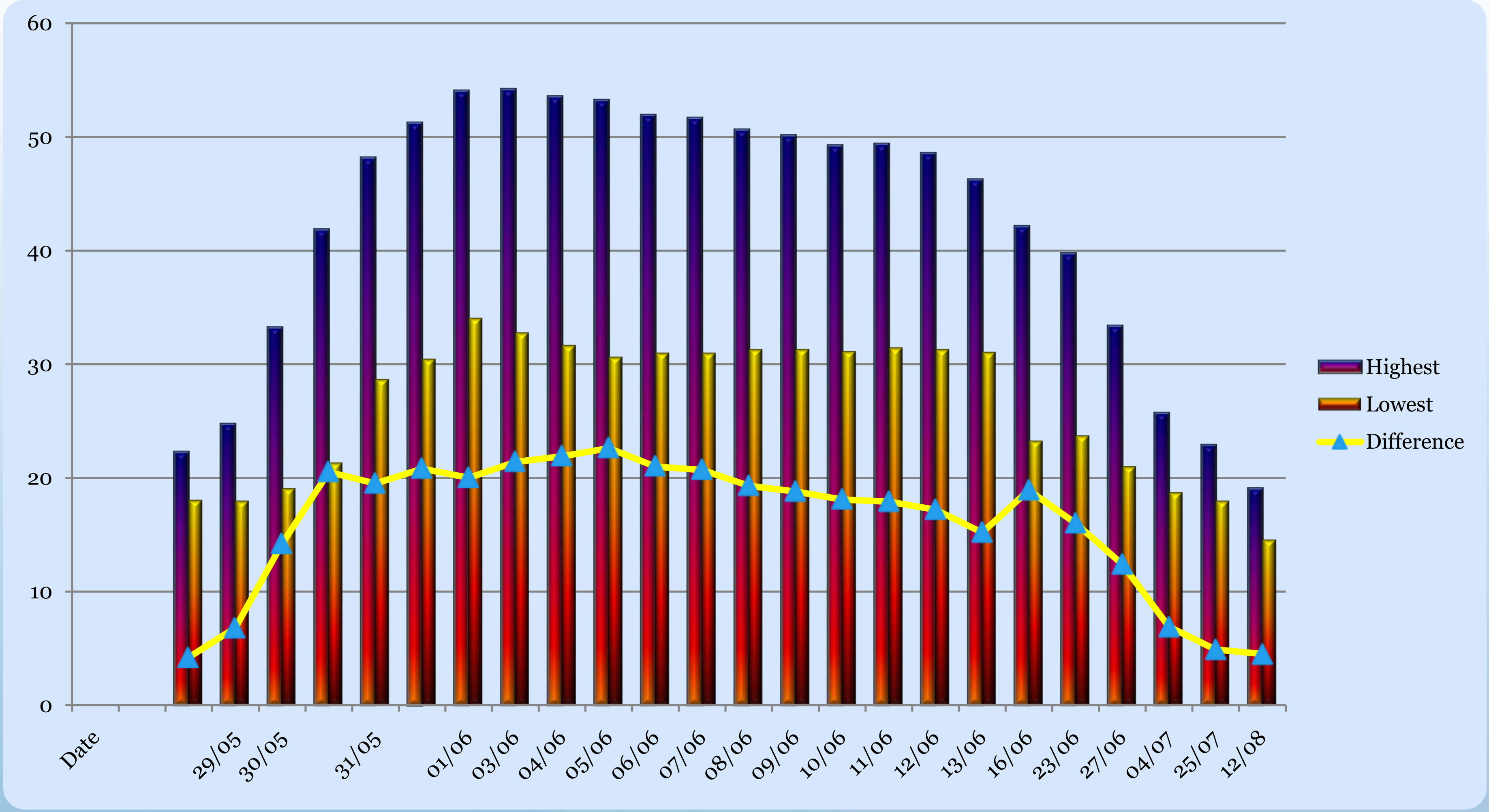


70% GGBS
19 degrees

ECOCEM

Controlling thermal cracking

20m x 20m x 2.4 m deep base with 70% GGBS



ECOCEM

Controlling thermal cracking

Image courtesy of Wind Farm Civils

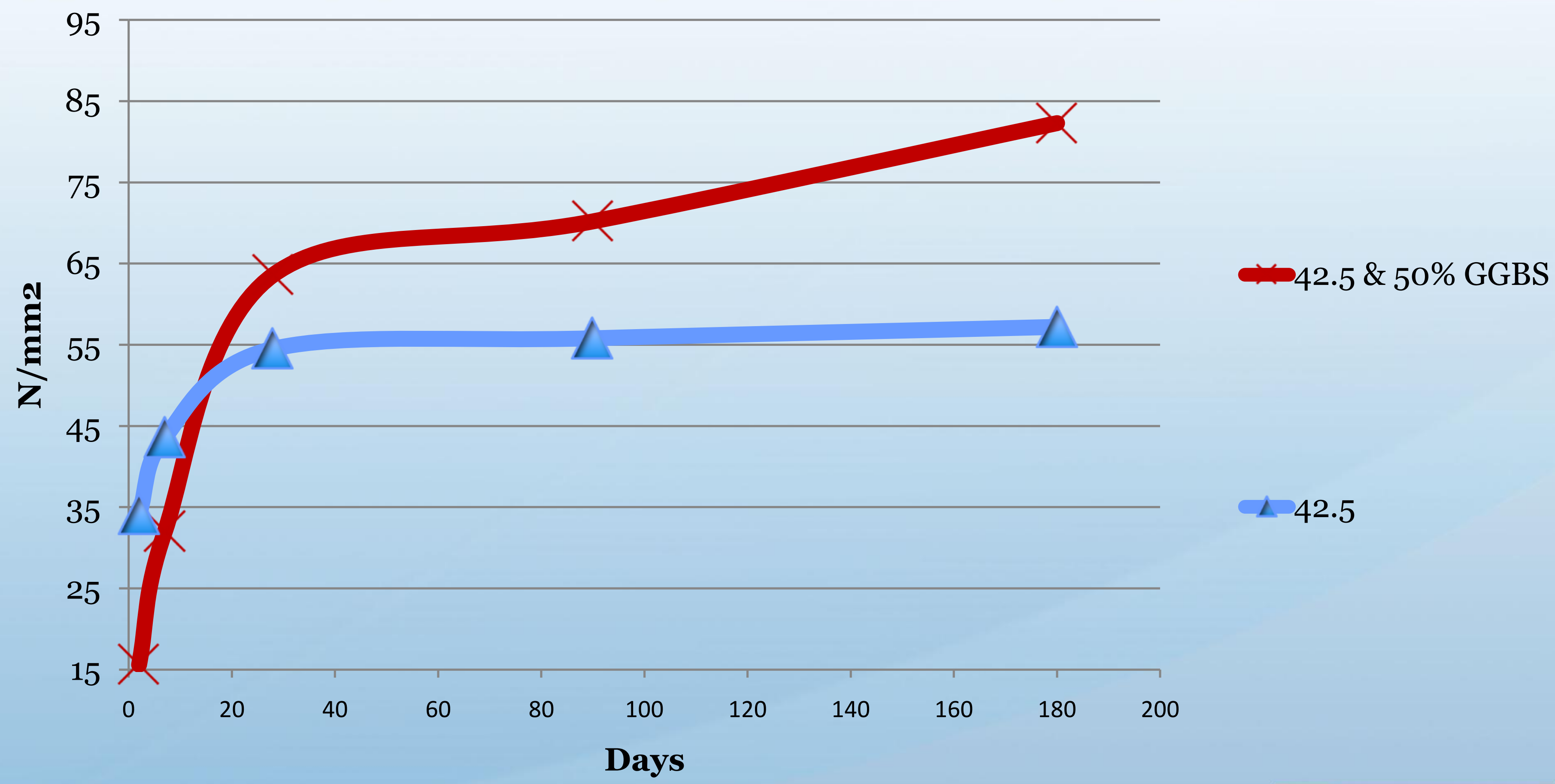
ECOCEM

Controlling thermal cracking

- Maximise use of GGBS to reduce heat generated
- Install and monitor thermocouples
- Insulate if required
- Minimise placing temperature
- Cover with plastic sheeting to protect from wind
- Remove insulation in stages

GGBS – strength benefits

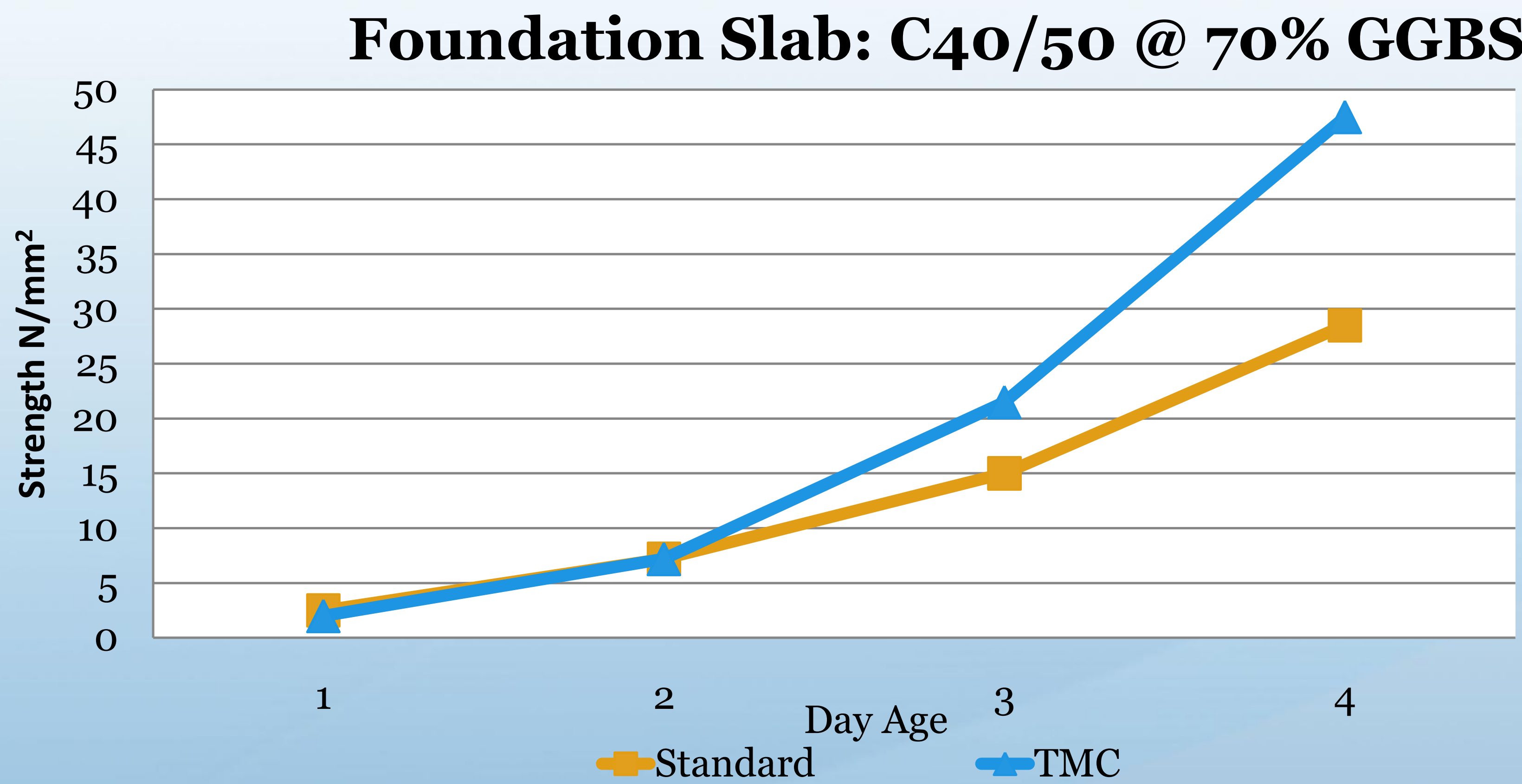
Long term strength development



ECOCEM

Temperature matched curing

1.1m deep base with 70% GGBS



ECOCEM

GGBS – Durability benefits

Durability – increased resistance to acids

Peaty soils – acidic environment

Table 6. Average Loss and Percentage Loss of Compressive Strength as a Result of Exposure to Silage Effluent

Sample	Average loss in compressive strength (N/mm^2)	% loss in compressive strength
100% OPC	7.05	46.74
30% GGBS	5.79	32.74
50% GGBS	4.11	21.82

Table 7. Average Mass Loss as a Result of Ten Cycles of Immersion in $MgSO_4$ Solution

Sample type	% average mass loss
OPC	3.5–2.8
30% GGBS	1.5–1.4
50% GGBS	1.2–0.8

Study of the Durability of OPC versus GGBS Concrete on Exposure to Silage Effluent

S. Pavía[1] and E. Condren[2]

0% GGBS

30% GGBS

50% GGBS

ECOCEM

Durability – increased resistance to sulphates

Table NA.7 Recommended limiting values for aggressive chemical environments exposure classes

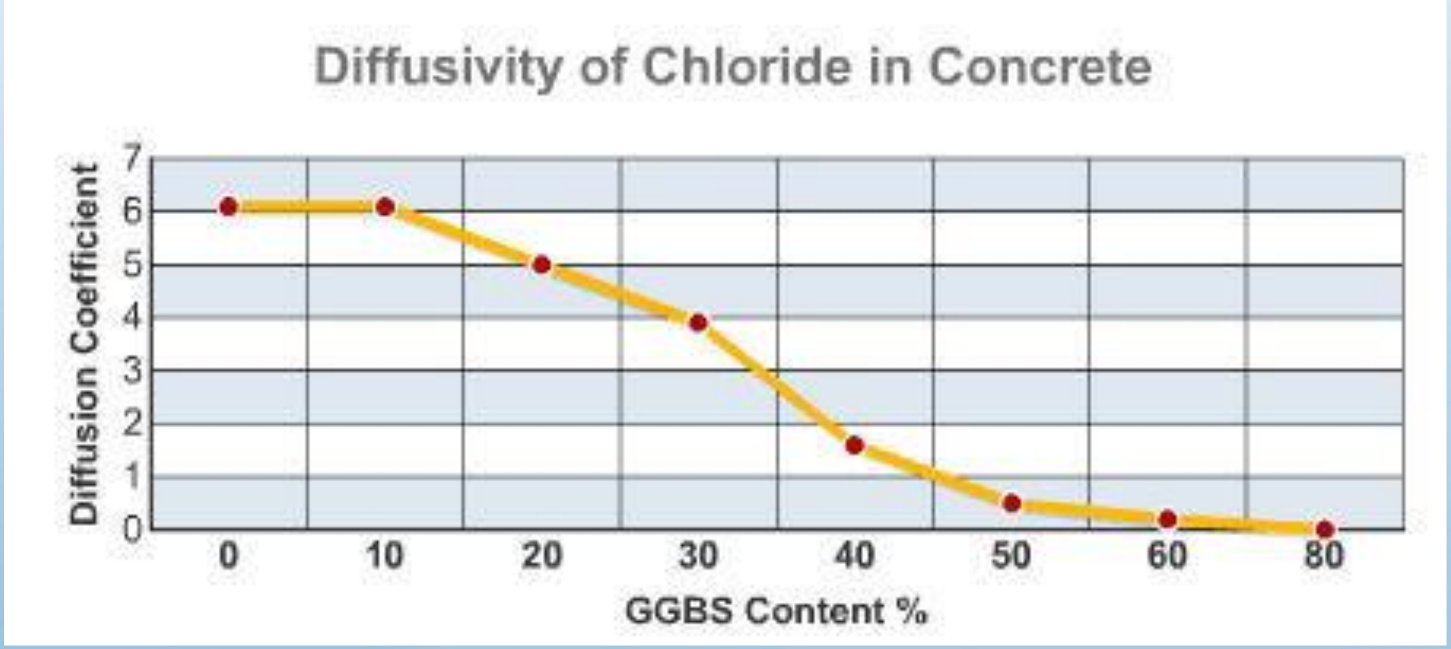
Exposure Class	Min. Strength Class	Max. W/C Ratio	Min cement content	Cement Type
XA1	C32/40	0,50	340	CEM I, CEM II/A-L,LL, CEM II/A-V, CEM II/A-S or combinations with GGBS up to 49%
	C30/37	0,55	320	SRPC, CEM III/A, CEM III/B or equivalent combination (see Note 1)
XA2	C35/45 (see Note 3)	0,50	360	CEM I, CEM II/A-L, LL, CEM II/A-V, CEM II/A-S, CEM II/B-V, CEM III/A or equivalent combination
	C30/37 (see Note 2)	0,50	320	SRPC, CEM III/B or equivalent combination
XA3	C40/50 (see Note 3)	0,45	400	CEM I, CEM II/A-L, LL, CEM II/A-V, CEM II/A-S, CEM II/B-V, CEM III/A or equivalent combination
	C32/40 (see Note 2)	0,45	360	SRPC, CEM III/B or equivalent combination

ECOCEM

Durability – increased resistance to salts

Marine Environment

- Lower chloride ion diffusivity
- Lower porosity/permeability



ECOCEM

Durability – increased resistance to salts

Permitted proportions for combinations (% by mass)	ggbs	⩽35	35 <ggbs< 80	50 <ggbs<80
	pfa	⩽20	20 <pfa< 55	35 <pfa< 55
Max. w/c ratio[b,c,e]		0.40	0.50	0.50
Min. cement content (kg/m^3)[b]		400	360	360
Min. cover to reinforcement[g,f]		60	50	40

BS 6349 – Maritime Structures – Table 22

ECOCEM

Summary

- Environmental
  - Positive PR
  - Assist with planning applications
  - Consistent ethos
- Reduced risk of cracking
  - Longer life
  - Reduced maintenance
- Increased long term strength
- Improved durability
  - Increased resistance to attack in peaty/acidic environments
  - Increased resistance to attack in marine environments

David O'Flynn doflynn@ecocem.ie 087 9654891

ECOCEM