- Project Partners and Sponsors
- Sulphate Activated Pozzolans
- Controlled Low Strength Materials
- Sources of Gypsum
- Other Materials
- Lab results
- Site Trial



## **Project Partners**

#### • Coventry University

- Dr Peter Claisse
- Dr Esmaiel Ganjian
- Elevtherios Gross

#### Imperial College London

- Professor Alan Atkinson
- Dr Mark Tyrer
- Rosemary Greaves

#### • Birmingham University

• Dr Gurmel Ghataora



## **Project Sponsors**

- The Mini-Waste Faraday Partnership
  - The Environmental and Physical Sciences Research Council
  - The Natural Environment Research Council
- Lafarge Plasterboard
- Huntsman Tioxide



## The Mini-Waste Gypsum Project

- Sulphate activated pozzolans
  - Controlled Low Strength Materials
  - Products (blocks, floor screeds etc.)
  - Trench fill
  - Road bases
- Self-heated product forming
- Production of clean gypsum



- Project Partners and Sponsors
- Sulphate Activated Pozzolans
- Controlled Low Strength Materials
- Sources of Gypsum
- Other Materials
- Lab results
- Site Trial



## Sulphate Activated Pozzolans

- Super Sulphated Cement was made with blastfurnace slag and gypsum
- Widely used for foundations because of high sulphate resistance
- Discontinued due to poor shelf-life and the introduction of sulphate resisting cements.



- Project Partners and Sponsors
- Sulphate Activated Pozzolans
- Controlled Low Strength Materials
- Sources of Gypsum
- Other Materials
- Lab results
- Site Trial



## Controlled Low Strength Materials

- Low strength mixes for trench backfill etc.
- Not yet widely used in Europe.
- An alternative to foamed concrete for many applications.



- Project Partners and Sponsors
- Sulphate Activated Pozzolans
- Controlled Low Strength Materials
- Sources of Gypsum
- Other Materials
- Lab results
- Site Trial



## Current Uses of Gypsum

#### CLEAN MATERIAL

- cement
- plasterboard and plaster

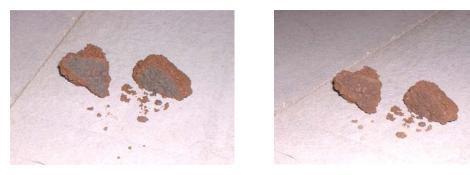
#### CONTAMINATED MATERIAL

• soil conditioner



## Sources of by-product Gypsum

- Flue gas desulphurisation
- Titanium oxide pigment production



- Plasterboard off-cuts
- Spent casting cores etc.

ACI Convention New York



# Red Gypsum

- A by-product of titanium dioxide production (white pigment).
- The red colour comes from iron oxide
- Many other contaminants

**ACI** Convention

**New York** 

- Has been used in agriculture
- Current output 125,000 Tonnes per year



## Red gypsum delivery at Roxby



ACI ConventionCOVENTRY UNIVERSITY CIVIL ENGINEERING GROUPNew YorkDr Peter Claisse



## Placed red gypsum at Roxby



ACI Convention COV New York



# Waste Plasterboard European Union Regulations

- Must be segregated on site
- Limited amounts can be recycled in the production process
- Cannot be landfilled with municipal waste (produces small amounts of hydrogen sulphide)
- No segregated cells available in the UK
- The organic content (paper) may prevent all landfilling





- Project Partners and Sponsors
- Sulphate Activated Pozzolans
- Controlled Low Strength Materials
- Sources of Gypsum
- Other Materials
- Lab results
- Site Trial



### Candidate materials (1)

- Sodium sulphate slag (Britannia Refined Metals Ltd.)
- Spent borax slag (Britannia Refined Metals Ltd.)
- Ferrosilicate slag (lumps from Britannia Refined Metals Ltd. sand size from Britannia Zinc Ltd.)
- Ferrosilicate copper slag (IMI Refiners Ltd.)
- Soda slag (Britannia Refined Metals Ltd.)
- Chrome Alumina slag (London & Scandinavian Metallurgical Co. Ltd.)
- Cement Kiln Dust ,CKD (Rugby Cement)
- Run of station ash (Ash Resources Ltd.)
- Lagoon ash (UK quality Ash Association)
- PFA (Ash Resources Ltd.)
- Steel slag (Tarmac Quarry Products Ltd.)
- Granulated Blast Furnace Slag, GBS (Tarmac Quarry Products Ltd.)



## Candidate materials (2)

- Burnt Oil Shale (Tarmac Quarry Products Ltd.)
- By-product Gypsum (Biffa Waste Services Ltd.)
- Glass cullet (Mercury Recycling Ltd.)
- GGBS (Ground granulated blastfurnace slag)
- Limex70 (British Sugar Plc.)
- Shell foundry sand (Bruhl UK Ltd., Hepworth Minerals & Chemicals Ltd.)
- Green foundry sand (Castings Plc. And Bruhl UK Ltd.)
- Fire kettle setting (Britannia Refined Metals Ltd.)
- Fine rotary fascia bricks (Britannia Refined Metals Ltd.)
- Sodium sulphate solution (Britannia Refined Metals Ltd.)



- Project Partners and Sponsors
- Sulphate Activated Pozzolans
- Controlled Low Strength Materials
- Sources of Gypsum
- Other Materials
- Lab results
- Site Trial



### Initial Strength Results

4												
	Percentag											
					Dry Run		Steel					
Water/			Limestone	Cement				Steel Slag	'	/		
solids	Red	Plasterboard	calciner	Kiln	Stantion	Slag	Dust,	Dust	3 day	7 day	28 day	
ratio	Gypsum	Gypsum	dust	Dust	Ash	Dust	ground	weathered	strength	strength	strength	
0.16	15	0	0	5	0	80	0		0.5	0.7	2.3	
0.19	0	15	0	5	0	80	0		0.2	0.5	1.5	
0.20	20	0	0	0	0		80		0.2	0.5	2.3	
0.36	20	0	20	20	20		20		0.1	0.2	2.1	
0.26	15	0	1	4	0	80	0		0.6			
0.20	15	0	0	5	0	80	0		1.8			
0.00	0	15	0	5	0		0	80	1.0			



- Project Partners and Sponsors
- Sulphate Activated Pozzolans
- Controlled Low Strength Materials
- Sources of Gypsum
- Other Materials
- Lab results
- Site Trial



#### Site Trial Mix

- 1 Part Water
- 2 Parts Red Gypsum (40% water as supplied)
- 3 Parts Steel Slag (Basic Oxygen Slag)



## Gypsum/Slag mix trial pour (mixing)



ACI Convention New York



### Gypsum/Slag mix trial pour





ACI Convention New York



#### Thank You

#### www.claisse.info

ACI Convention New York

