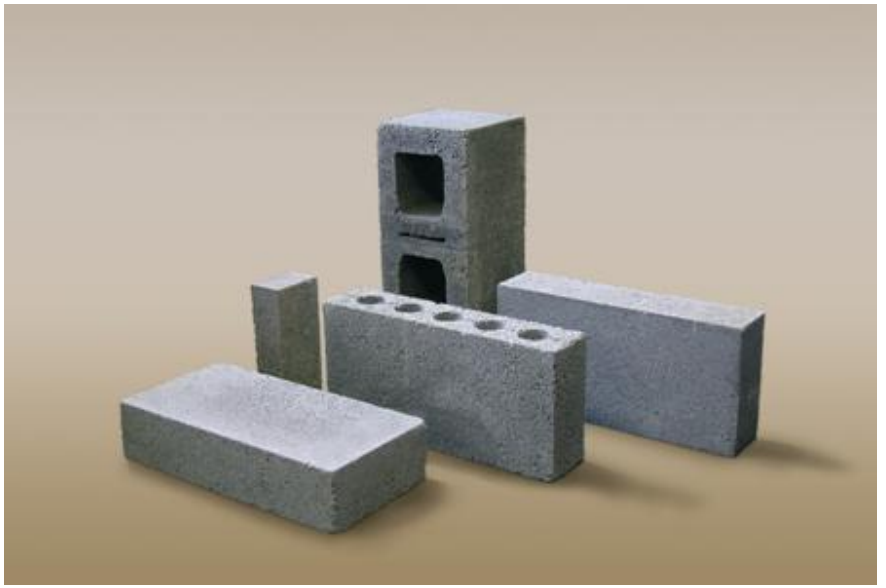
Business case for using microwave technology to produce a lightweight aggregate



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Presented by Ian Holton

Project background

- Nottingham University had developed a method of producing lightweight aggregate from quarry wastes using microwave technology
- Outline business case prepared by Scott Wilson to examine the commercial feasibility of putting this method into full-scale production
- Assess energy requirements and CO_2 emissions
- Work funded by the Mineral Industry Sustainable Technology Programme (MIST)
- Undertaken in collaboration with the University of Nottingham, the Minerals Product Association, the UK Quality Ash Association and Tarmac Concrete Products

Today's presentation

- Stages in the development of the business case
  - Market appraisal
  - Cost estimation (set-up and production)
  - Investment appraisal
  - Sensitivity
- CO_2 and energy
- Conclusions and recommendations

Market appraisal

- 25.2 million m^2 of lightweight concrete blocks produced in the UK in 2006
- 2 million tonnes of lightweight aggregate
  - Furnace bottom ash (FBA) – 50%
- Supplies of FBA expected to reduce
- Alternative UK source of aggregate required
- Potential market for 330,000 tonnes of lightweight aggregate in short-term, possibly 500,000 tonnes in long-term

Cost estimation

- Real data from the industry and laboratory trials

- A1: Production facility at block plant producing 70/30 PFA/quarry fines lightweight aggregate
- A2: Production facility at block plant producing a PFA only lightweight aggregate
- B: Production facility at power station producing a PFA only lightweight aggregate

- Power station to block plant = 15 miles
- Quarry to block plant = 43 miles

Cost estimation

Considered:

- Materials, Energy, Transport, Labour
- Allowed for increases in these costs

	Cost/tonne
Option A1	£18 – 32
Option A2	£16 – 28
Option B	£11 – 16
FBA	£10 – 20
Pumice	£25 – 30

Investment appraisal

- Net Present Value (NPV) calculation
- Based on value of money over time

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- 4 MW facility costing £6 million
- Producing 165,000 tonnes of lightweight aggregate under the different cost options
- Selling at £25 per tonne
- 10 year life for the facility

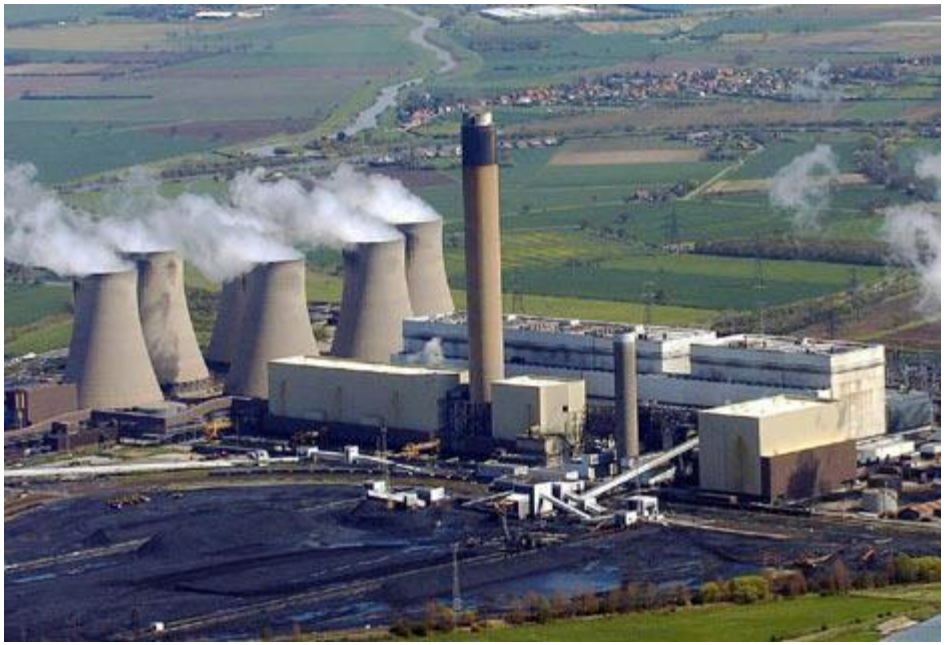
NPV: Option B

(£10.52/tonne to produce, selling at £25/tonne)

Year	Cash flow, £	Discounted, £	Balance, £
0	- 6,000,000	- 6,000,000	- 6,000,000
1	2,389,200	2,264,644	- 3,735,355
2	2,389,200	2,146,582	- 1,588,773
3	2,389,200	2,034,675	445,902
4	2,389,200	1,928,602	2,374,504
5	2,389,200	1,828,059	4,202,564
6	2,389,200	1,732,757	5,935,321
7	2,389,200	1,642,424	7,577,745
8	2,389,200	1,556,800	9,134,545
9	2,389,200	1,475,640	10,610,185
10	2,389,200	1,398,711	12,008,896

Viable financially

NPV result positive after:
A1 – 7 years
A2 – 5 years
B – 3 years



Sensitivity

NPV calculations also used to examine effects of:

- **Changes in production costs**
- **Changes in selling price**

NPV: Option B

(£17.52/tonne to produce, selling at £25/tonne)

Year	Cash flow, £	Discounted, £	Balance, £
0	- 6,000,000	- 6,000,000	- 6,000,000
1	1,234,200	1,169,858	- 4,830,142
2	1,234,200	1,108,870	- 3,721,272
3	1,234,200	1,051,062	- 2,670,211
4	1,234,200	996,267	- 1,673,944
5	1,234,200	944,329	- 729,615
6	1,234,200	895,098	165,484
7	1,234,200	848,434	1,013,918
8	1,234,200	804,203	1,818,121
9	1,234,200	762,278	2,580,399
10	1,234,200	722,538	3,302,938

NPV: Option B

(£10.52/tonne to produce, selling at £15.78/tonne)

Year	Cash flow, £	Discounted, £	Balance, £
0	- 6,000,000	- 6,000,000	- 6,000,000
1	867,900	822,654	- 5,177,346
2	867,900	779,767	- 4,397,579
3	867,900	739,116	- 3,658,464
4	867,900	700,583	- 2,957,880
5	867,900	664,060	- 2,293,820
6	867,900	629,441	- 1,664,379
7	867,900	596,626	- 1,067,753
8	867,900	565,523	- 502,230
9	867,900	536,040	33,810
10	867,900	508,095	541,906

Energy and CO_2

- **Production and transportation**

- **A1** Power station —PFA→ Block plant ←fines— Quarry
- **A2** Power station —PFA→ Block plant
- **B** Power station —LWA→ Block plant
- **Control** Greece —pumice→ UK

Energy consumption (MJ/tonne LWA)

	A1	A2	B	Control
Production	828	720	684	42
Transport	40	25	25	682
Total	868	745	709	724

CO_2 emissions (kg/tonne LWA)

	A1	A2	B	Control
Production	113.4	98.6	93.7	3.8
Transport	3.1	2.0	2.0	51.9
Total	116.5	100.6	95.7	55.7

Conclusions (1)

- Good market potential in the UK for lightweight aggregate produced using this technology
- The technology has the potential to produce lightweight aggregate at lower cost than importing natural equivalents
- Additional benefit of reducing consumption of natural resources and reducing the amount of waste disposed of to landfill
- NPV calculations showed that it was viable to establish a full-scale production facility
- The best location for a facility was at the power station

Conclusions (2)

- Energy consumption ~ importing pumice
- CO_2 emissions > importing pumice
- Potential barrier to uptake
- Further assessment of sustainability impacts required (social, economic and environmental)

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