Novacem – carbon negative cement to transform the construction industry

Innovation and Investment Opportunities in Carbon Capture and Storage

Energy Futures Lab, Imperial College
London • 15 October 2008
The Novacem proposition

Novacem will transform the construction industry with a new carbon negative cement that will replace Portland cement

- Portland cement is a pervasive and important material (US$150Bn/year) but accounts for about 5% of man-made CO₂ emissions
- Novacem has invented a new type of cement that has the potential to achieve cost and performance parity with Portland cement
- Best of all, our cement uses less CO₂ in its manufacture and then absorbs CO₂ as it cures. Compared to Portland cement, we have an advantage of approx 1 tonne of CO₂ per tonne of cement
- Novacem is a spin-out from Imperial College, London
  - Five year pipeline agreement with 5* Civil Engineering Department
  - Seed funding from Imperial Innovations (AIM: IVO.L)
  - Building word class team under Chairman Stuart Evans
  - Leads £1.5Mn Technology Strategy Board (TSB) project with partners Rio Tinto Materials, Laing O'Rourke, WSP and Imperial College
  - Labs and offices in the Imperial Incubator
Novacem and Imperial College

In the world of innovative high tech firms, universities and young start-ups are often closely linked. But they have different (although complementary) objectives

- **Imperial College**: a machine for turning Money into Knowledge
- **Novacem**: a machine for turning Knowledge into Money

The Novacem Chairman has deep experience of taking great inventions from great universities and turning them into great companies.
Portland cement is socially and economically essential but has a high carbon footprint

A: \[ \text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2 \]

B: \[ \text{CaO} + \text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3 \rightarrow \text{“clinker”} \]

clinker + calcium sulphate = cement

aggregates + cement (‘binder’) = concrete
Novacem has invented a new carbon negative binder based on Magnesium Oxide (MgO)

**Portland Cement**

- **CaCO₃** (limestone) → **CaO** + **SiO₂** + **Al₂O₃** + **Fe₂O₃** + additives
- **900°C** → **Clinker** → **Cement**
- **CO₂** from fossil fuel

**Novacem**

- **Magnesium silicate** → **MgO** + proprietary additives
- **700°C** → **MgO** → **Cement**
- **CO₂** from fossil fuel
Novacem will win in both production and use

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<thead>
<tr>
<th></th>
<th>Production</th>
<th>Use</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Portland</td>
<td>0.8/1.1</td>
<td>(0.2/0.5)</td>
<td>0.4</td>
</tr>
<tr>
<td>Novacem</td>
<td>0.2/0.4</td>
<td>(0.9/1.1)</td>
<td>(0.6)</td>
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</tbody>
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Novacem Advantage (1.0)

*tonnes of CO$_2$ generated/(absorbed) per tonne of cement*

*Source: Imperial College/Novacem research*

The big win is that if Novacem completely replaced Portland, cement would absorb about 5% of man-made CO$_2$ emissions rather than generate 5%
A great start to building a world-class team

Stuart Evans, Executive Chairman. An entrepreneurial business leader since 1984, was founding CEO at Plastic Logic and Cotag International. Early career at IBM & McKinsey following Harvard MBA & Cambridge BA/MA. Full profile at www.linkedin.com/in/stuartevans

Dr Nikolaos Vlasopoulos, Chief Scientist. PhD and MSc at Imperial College, following MEng at Democritus University of Thrace in Greece. Received Technology Venture Fellowship at Tanaka Business School in 2007.

Dr Chris Cheeseman, Senior Scientific Advisor. Reader in Waste Management in Civil and Environmental Engineering at Imperial. Leads large research group in resource efficiency & reuse of materials. Over 100 scientific papers. Oxford DPhil.

Daniel Ptacek, Business Development/Project Management. Over 25 years’ construction industry experience in Europe and USA including Laing, Tarmac, Amey and others. Worked on the Millennium Dome and GSK Labs at Stevenage.
Our leadership of £1.5Mn TSB project with key industrial partners is impressive early validity of our technology

**WSP**

**Novacem**

**WSP**

**Magnesium silicate** → **MgO** → **Binder** → **Building Products** → **End User**

**Rio Tinto**

Leading global mining & exploration company with £30Bn sales and 47,000 employees

www.riotinto.com

**Laing O’Rourke**

Largest privately held integrated UK construction firm, with 27,000 employees worldwide.

www.laingorourke.com

**WSP**

Engineering & design company serving the built and natural environment

www.wspgroup.co.uk

**Imperial College London**

World class science-based university focused on science/engineering and application to industry.

www.imperial.ac.uk
**Business model and investors for platform technologies**

- Novacem needs to develop and prove our technology and will require a pilot plant prior to scalable volume production. We still have to determine size/location but this is an important goal for the TSB project.
- Cement industry is globally fragmented – the top 4 companies are only 14% of industry revenues. Its much more concentrated in the UK, but Novacem is playing a global game.
- This is a big job and we can’t do it on our own. We aim to build a eco-system of investors and partners that can make a real difference. And governments have an important contribution to make as well.
- We don’t plan to have our own cement plants, but will make our technology available to others on competitive and compelling terms.
- Imperial Innovations is a great seed investor. From this foundation, we will build a high quality group of global financial and corporate investors.
- But remember, business models usually change in high tech start-ups developing platform technologies. As we develop our technology and get out into the market, we’ll learn more about what it takes to win.
## Novacem milestones

<table>
<thead>
<tr>
<th>Event</th>
<th>Timing</th>
</tr>
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<tbody>
<tr>
<td>Basic research at Imperial College</td>
<td>2005 onwards</td>
</tr>
<tr>
<td>Innovations starts seed funding in stealth mode</td>
<td>Oct 2007</td>
</tr>
<tr>
<td>Wins TSB project</td>
<td>April 2008</td>
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<tr>
<td>Moves into Incubator</td>
<td>Oct 2008</td>
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<tr>
<td>Bench scale process in the lab</td>
<td>Oct 2009</td>
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<tr>
<td>Testing and validation</td>
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<td>- Building products (eg, blocks)</td>
<td>Aug 2010</td>
</tr>
<tr>
<td>- Reinforced structural concrete</td>
<td>Aug 2010</td>
</tr>
<tr>
<td>Pilot plant operational</td>
<td>Aug 2010</td>
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In competitive terms, it’s still early days with everything to play for

- The traditional cement industry is under pressure\(^1\) to tackle the carbon problem and is following a fourfold strategy:
  - Using pozzolans to blend with Portland cement
  - Including mineraliser additives to reduce process temperatures
  - Energy efficiency/using green fuels
  - CO\(_2\) sequestration
- Other new entrants are emerging, including
  - Calera, California
  - TecEco, Australia
  - C-Fix, Holland
  - Calix, Australia

We have a healthy respect for these companies (whose existence reassures us we are onto a good thing), but know where we have advantages

Note 1 - see, for example, Cement vs Carbon, Credit Agricole, Sept 2008
Conclusion

- There is an unprecedented and urgent imperative. As John Doerr\(^1\) put on Monday: “You can bail out the banks; you can’t bail out the environment”
- Consumers and their governments are demanding the construction industry change its ways
- This is a great opportunity to move from invention & research to customers & products – the race is on!
- Many different elements in the emerging value chain need to work together to deliver the best solution for consumers
- We welcome the opportunity to discuss these ideas with you, and thank you for your attention!

Note 1 – conversation with John Doerr, Partner at Kleiner Perkins at Harvard Business School – Monday 13 October after a week of unprecedented financial turmoil and government intervention
Great companies need great people

If you are a talented, hardworking and enthusiastic individual, interested in a career opportunity with Novacem, please submit your resume to:


careers@novacem.com
Thank you!

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