Cost and carbon results for innovative pigments being developed through the NanoPigmy research project

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NanoPigmy technical innovation targets

- Multi-functional construction pigments/materials

Pigment A	Pigment B
Colour	Colour
Thermal storage	Thermal storage
Anti-bacterial	Self-cleaning

Material A1	Material A2	Material B
Interior wall paint 	Interior polymer board for partitions 	External cement render 

Anticipated impacts from NanoPigmy materials

Pigment A Paint and Polymer Board	Pigment B Cement Render
Reduced cooling requirement, leading to lower energy use and lower life cycle cost	Reduced cooling requirement, leading to lower energy use and lower life cycle cost
Reduced need for cleaning in interior applications (toilets, kitchens) leading to lower costs and reduced use of cleaning products	Reduced need for exterior cleaning leading to lower costs
Increased costs to purchase paint and polymer board with innovative pigments	Increased costs to purchase render with innovative pigments
Increased carbon from additional raw materials in the pigment	Increased carbon from additional raw materials in the pigment

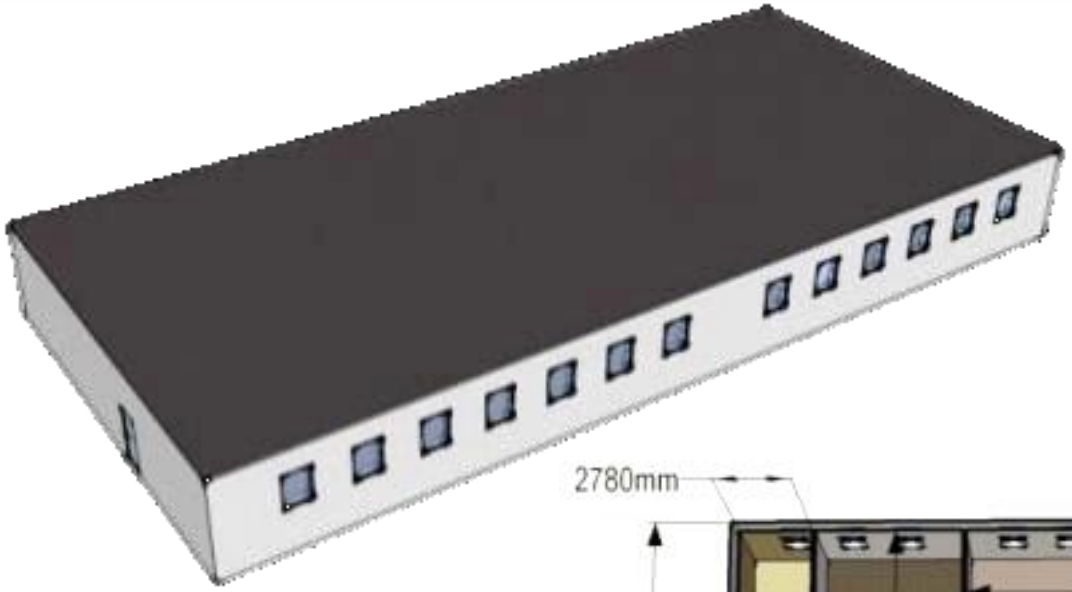
Interior paint and polymer board

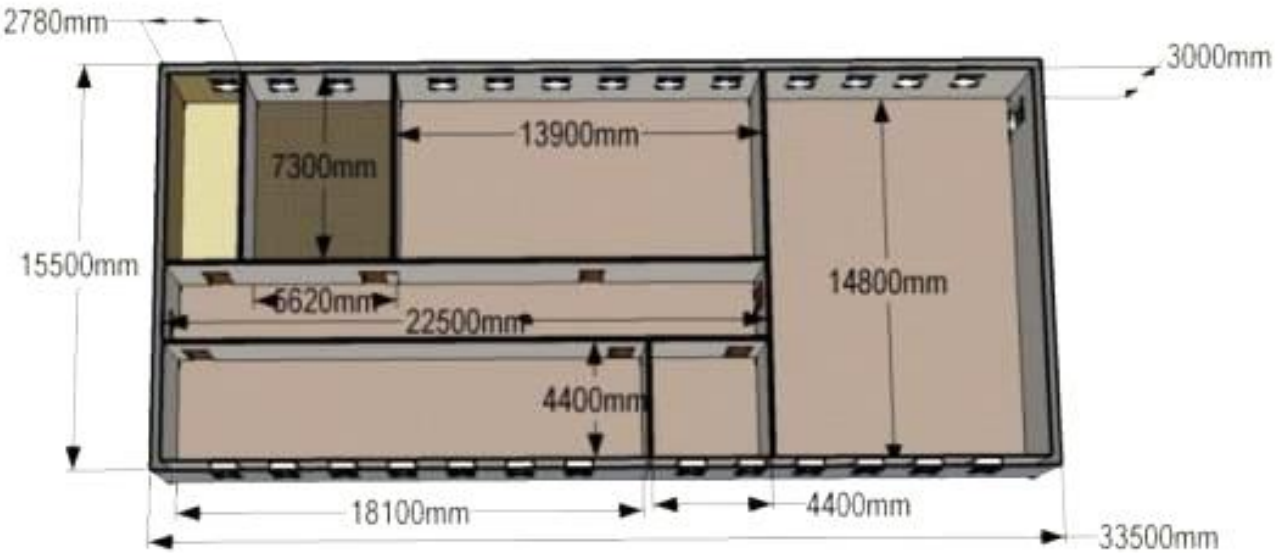
- Addition of PCM to provide thermal storage as room temperature increases
- Dosing of PCM is designed to be 44% of the finished pigment
- Raw PCM stores 125kJ/kg, in manufactured pigment this drops to ≈40kJ/kg
- Addition of Ag ions to provide antibacterial effect
- Laboratory tests show significant reduction in bacterial growth

Cement render

- Addition of PCM to provide thermal storage as room temperature increases
- Dosing of PCM is designed to be 44% of the finished pigment
- Raw PCM stores 125kJ/kg, in manufactured pigment this drops to ≈40kJ/kg
- Addition of TiO2 to provide self-cleaning effect
- Laboratory tests show increase in shedding of surface deposits

Office building used to model effects of NanoPigmy materials



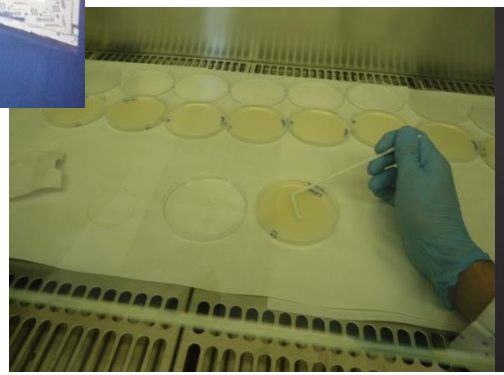


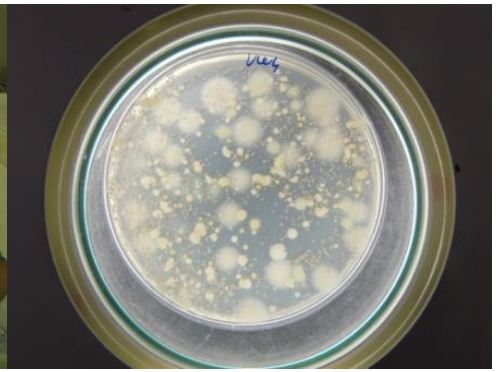
Laboratory formulations

- Tested in late 2013 based on laboratory trials
- Life cycle costs and environmental impacts assessed by BSRIA for a UK-sited office building
- Presented at CIBSE Technical Symposium in April 2014

Demonstration of paint & polymer board

- Demonstrators constructed and monitored by Acciona near Madrid





Demonstration of cement render

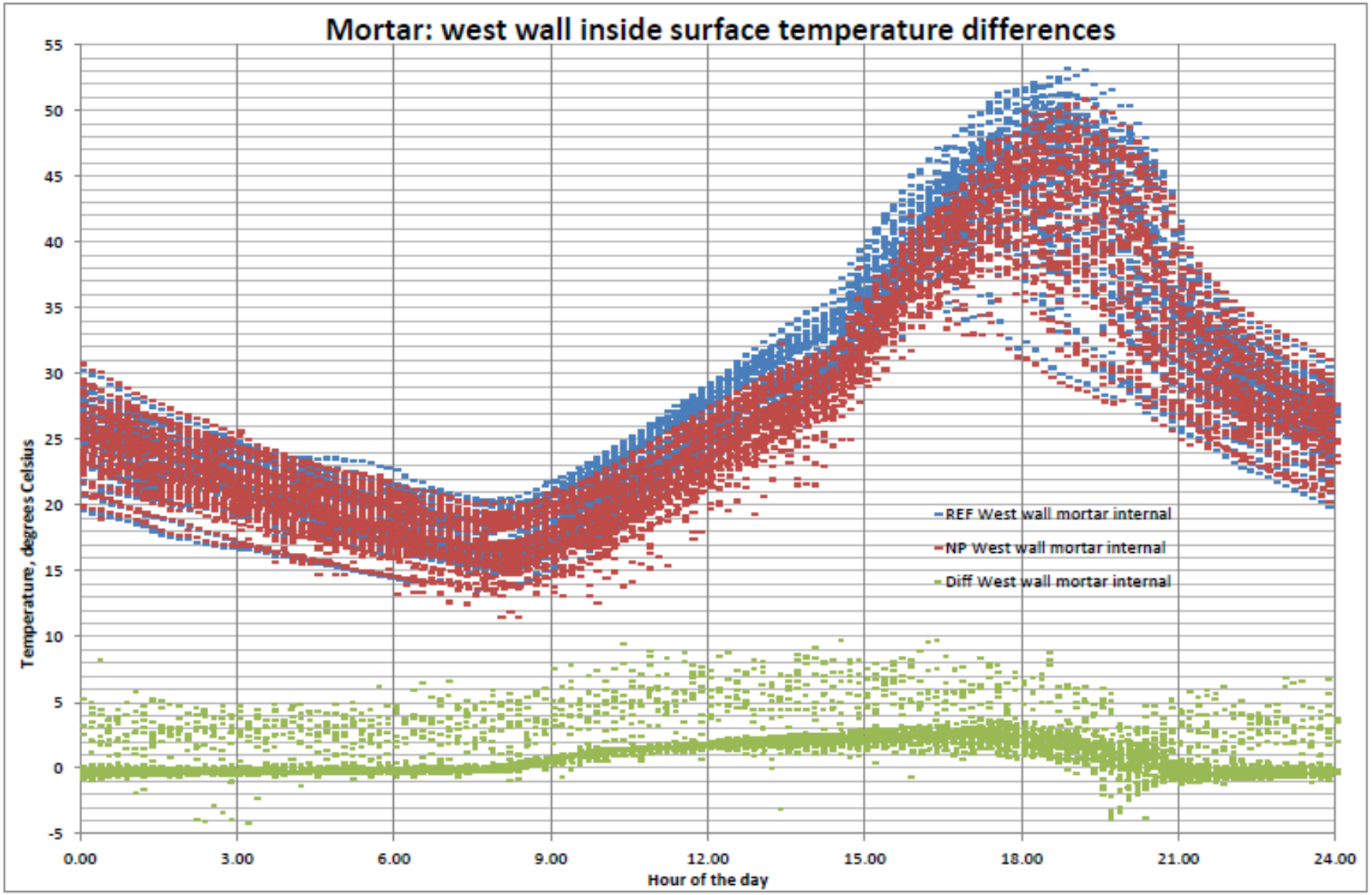
Update of example office

- Energy consumption based on Madrid location to match site of the demonstrators
- Frequency of internal cleaning reduced to more realistic levels
- Life expectancy of internal paint increased to reflect better durability from anti-bacterial effect
  - Would need to be confirmed from long-term testing

Demonstrator results

- Changes in material performance from the demonstrators
  - Internal temperature of the test cells is reduced in the demonstrators using the NanoPigmy paint, board and render
  - Bacterial growth is reduced on the NanoPigmy paint and board
  - The NanoPigmy render sheds dirt more readily than standard render
- These results have been incorporated into the life cycle cost and environmental impact models

Example of temperature differences seen

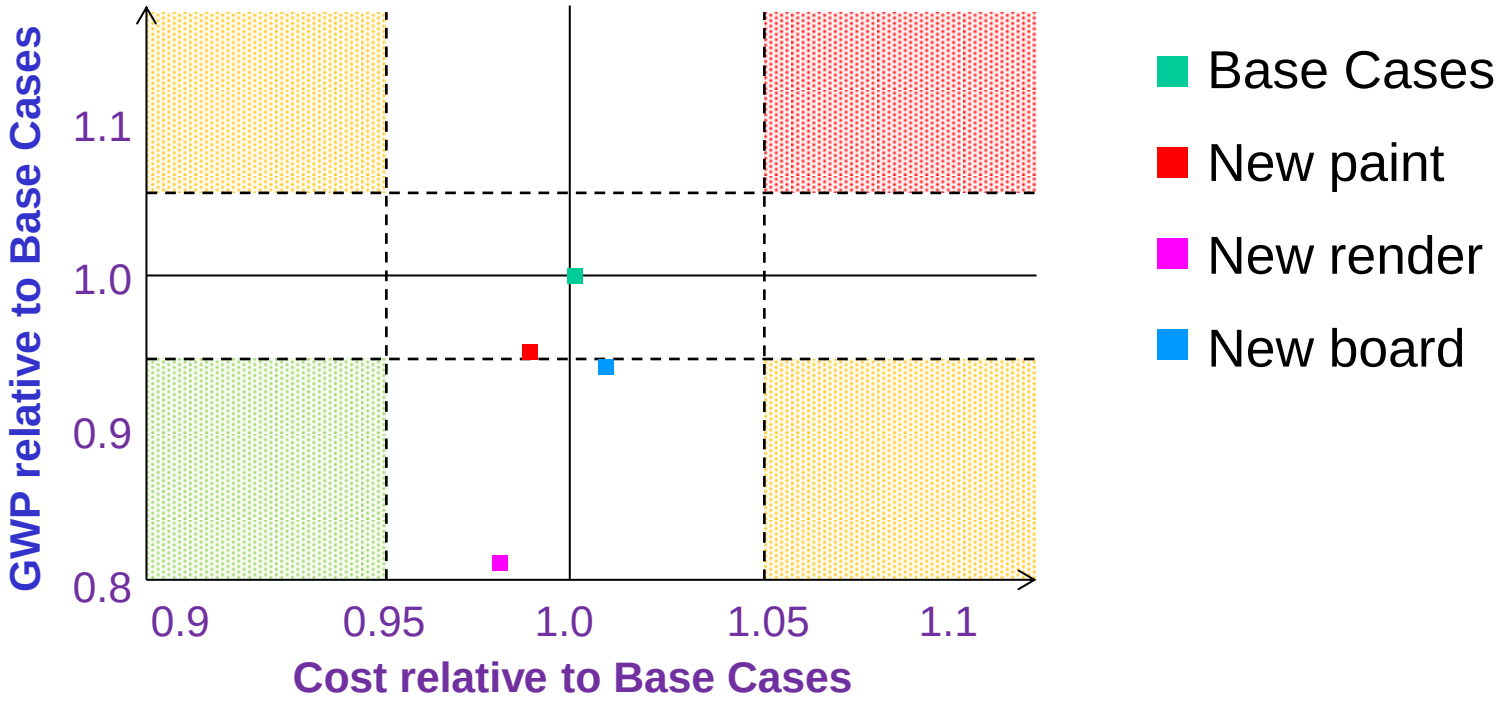


Summary of cost and carbon results

	Base Case 1	New paint	New render	Base Case 2	New board
Gas use	5804 kWh/y	5831 kWh/y	5944 kWh/y	5388 kWh/y	5383 kWh/y
Electricity use	11,311 kWh/y	10,515 kWh/y	7934 kWh/y	11,462 kWh/y	10,388 kWh/y
Maintenance cycle	5-yr Office 3-yr Toilet	7-yr Office 5-yr Toilet			
Cleaning regime	Toilet weekly, External wall yearly	Toilet wall monthly	External wall 3-yearly	Toilet weekly, External wall yearly	Toilet wall monthly
Life cycle cost 100yrs	£232,170	£227,050 SIR 6.7	£225,950 SIR 24.2	£233,010	£236,960 SIR 0.7
Life cycle carbon GWP	833,780 kgCO2-eq	797,500 kgCO2-eq	676,240 kgCO2-eq	825,150 kgCO2-eq	782,670 kgCO2-eq

Combined cost and carbon results

- LCC (cost) and GWP (carbon) results presented on a normalised 2x2 matrix
- Dotted lines show ±5% margin of error on totals



Conclusions

- All NanoPigmy pigments show reduced life cycle carbon emissions compared to traditional products
- At a discount rate of 6% …
- NanoPigmy paint and render show life cycle cost savings, but both are within the 5% margin of error
- NanoPigmy polymer board shows increased life cycle costs
  - But at discount rate of 3.5% this becomes a life cycle cost saving

- It is important to model the in-use part of the life cycle to give the full picture of cost and carbon

Thank you

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