Northumbria Research Link

Citation: Brown, Jean (2011) Cross-School Interdisciplinary Research. In: Northumbria Research Conference, 5 May - 6 May 2011, Northumbria University, Newcastle-upon-Tyne.

URL:

This version was downloaded from Northumbria Research Link: https://nrl.northumbria.ac.uk/id/eprint/2582/

Northumbria University has developed Northumbria Research Link (NRL) to enable users to access the University's research output. Copyright © and moral rights for items on NRL are retained by the individual author(s) and/or other copyright owners. Single copies of full items can be reproduced, displayed or performed, and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided the authors, title and full bibliographic details are given, as well as a hyperlink and/or URL to the original metadata page. The content must not be changed in any way. Full items must not be sold commercially in any format or medium without formal permission of the copyright holder. The full policy is available online: http://nrl.northumbria.ac.uk/policies.html

This document may differ from the final, published version of the research and has been made available online in accordance with publisher policies. To read and/or cite from the published version of the research, please visit the publisher's website (a subscription may be required.)

Northumbria University NEWCASTLE

UniversityLibrary

INTER-DISCIPLINARY CROSS SCHOOL RESEARCH

A JEAN E BROWN (SASS), PROFESSOR BRIAN AGNEW (BUILT ENVIRONMENT), GRAHAM KIMPTON (BUILT ENVIRONMENT), AND BOB BEST (APPLIED SCIENCES) & DAVID WILSON (BUSINESS ADVISOR)

INTRODUCTION

- The Charcoal Chiller Project
- The Dry Ice Project
- Outcomes
- Conclusion

THE CHARCOAL CHILLER PROJECT

- The charcoal chiller incorporates a refrigeration system that utilises the energy required for evaporation to provide cooling
- It will provide a low cost sustainable approach to cool storage for works of art, medicines and foodstuffs in regions of the world with a hot, dry climate and no electricity.

CROSS SCHOOL PROJECT TEAM

The project is a collaboration between:

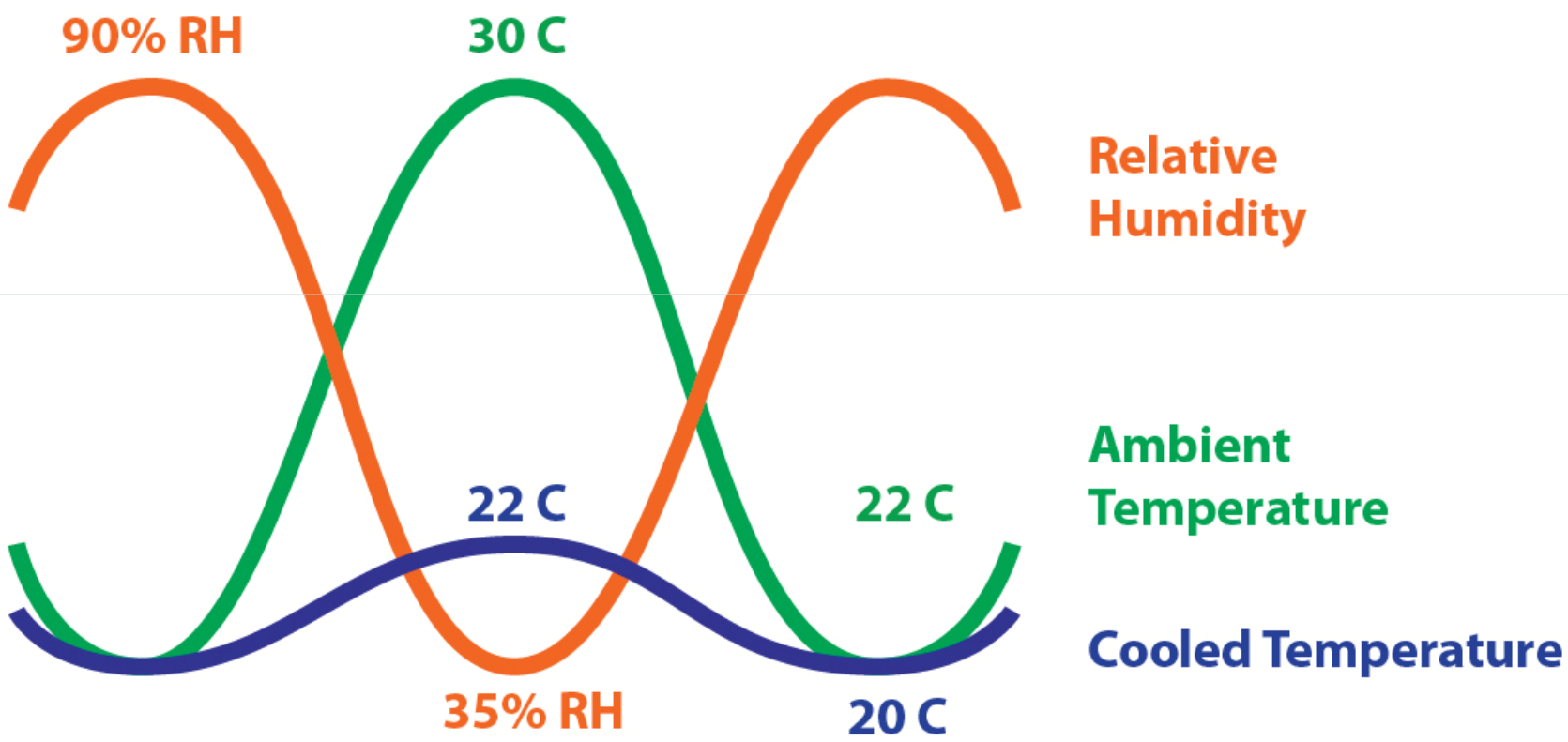
- A Jean E Brown (SASS)
- Professor Brian Agnew (Built Environment)
- Graham Kimpton (Built Environment)
- David Wilson (Business Advisor)

FUNDING

- The team was awarded ‘Commercial Venture’ funding by the Research Business Innovation team led by Graham Hopson
- The funding provided guidance from David Wilson a fund manager with David Wilson Associates as well as the cost of the materials required for the prototype

DESIGN CONCEPT

- The concept for the design has been used for a number of years in areas of North Africa to transport produce to market
- It is claimed that it can achieve an internal temperature as low as 17°C despite the external temperature being over 30°C.

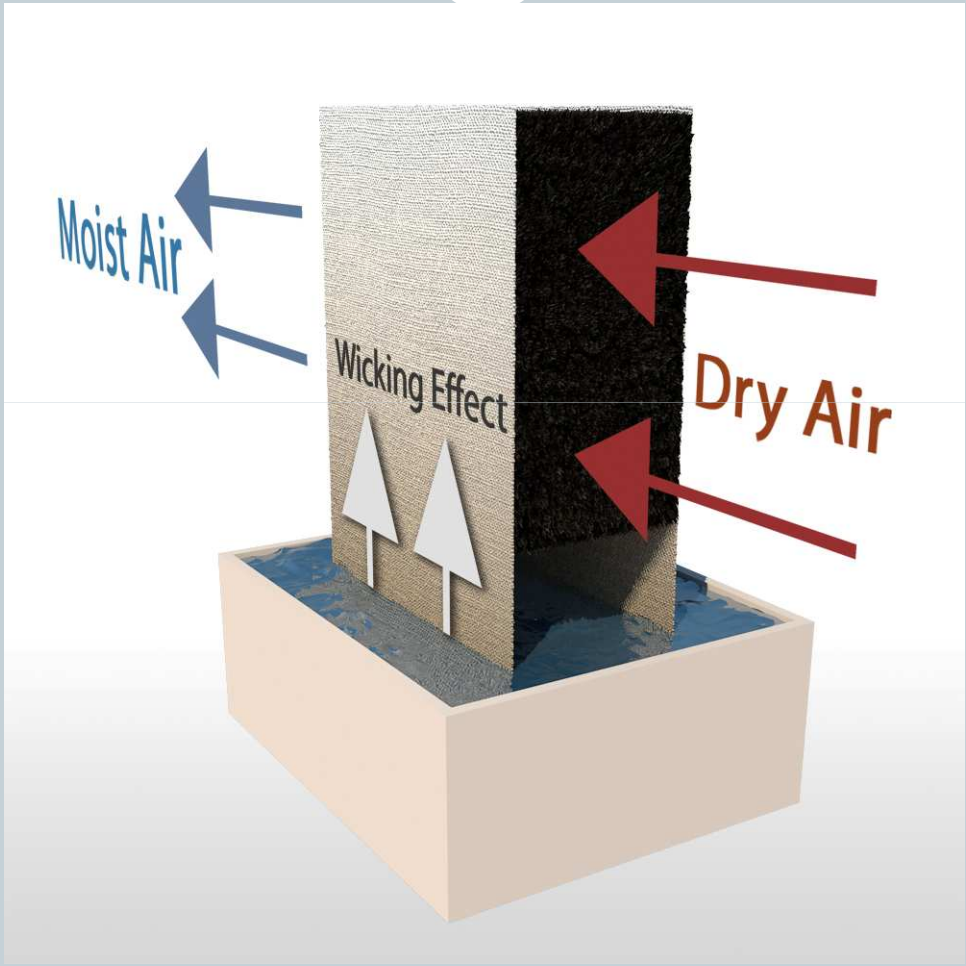

90% RH
30 C
Relative Humidity
Ambient Temperature
22 C
22 C
Cooled Temperature
35% RH
20 C

COMMERCIAL FOCUS

- The Charcoal Chilled Storage Unit will be attractive to anyone seeking a more sustainable approach to caring for produce or materials that can be adversely affected by high temperatures
- In the long term it would be interesting to investigate the maximum size for such a unit and whether the system could be used for an entire building

CHARCOAL CHILLER PROTOTYPE

- The prototype is a box that is encased in a layer of wet charcoal.
- The external temperature and air flow causes the water to evaporate and the energy for the process is drawn from the inside of the box resulting in a drop in the internal temperature.
- The charcoal is very effective since it is highly porous with a huge internal surface area from which the water can evaporate.


Moist Air
Wicking Effect
Dry Air

RESEARCH AIMS

The research aims to evaluate the impact on the evaporative process of different:

- Construction materials, structures & dimensions
- Sources of charcoal and their consequent variation in evaporative rate i.e. coconut, coal etc
- Types of charcoal i.e. lump, briquette, granular, powdered
- Thicknesses of charcoal
- Systems for wetting the charcoal
- External temperatures and air flow

METHODOLOGY

- Computer modelling has been used to visualise the design of the charcoal chiller
- The efficacy of materials, as well as their cost and carbon footprint have been factored into the design and decision making process
- A series of prototypes have been constructed and their effectiveness evaluated by measuring temperature and relative humidity at specific points i.e. internal and external air, respective surfaces etc

OUTCOMES & FUTURE DEVELOPMENTS

- It is anticipated that by the end of the project a charcoal chiller prototype will have been built and its efficiency and effectiveness demonstrated.
- It is hoped that the pilot project will contribute to a funding application to a research council
- It is hoped that the project will eventually result in a patent application
- In the long term it would be interesting to investigate the maximum size for a charcoal chiller and whether the system could be used for an entire building

THE DRY ICE PROJECT

Ingrained surface dirt is a problem in libraries and archives:

- It is unsightly
- If handled the dirt becomes further ingrained and/or transferred to other materials
- It is ingrained and therefore difficult to remove
- Traditional cleaning systems use abrasive techniques which are time consuming and risk damage to the surface of the materials

ADVANTAGES OF DRY ICE CLEANING

- Dry ice cleaning is non-toxic and ecologically friendly
- It does not present a chemical risk to materials of operators
- It offers more efficient and effective cleaning

CROSS SCHOOL PROJECT TEAM

The project is a collaboration between:

- A Jean E Brown (SASS)
- Bob Best (Applied Sciences)

FUNDING

- The project is part of a Knowledge Transfer Project (KTP) application that is funded by the Arts & Humanities Research Council (AHRC)

RESEARCH CONCEPT

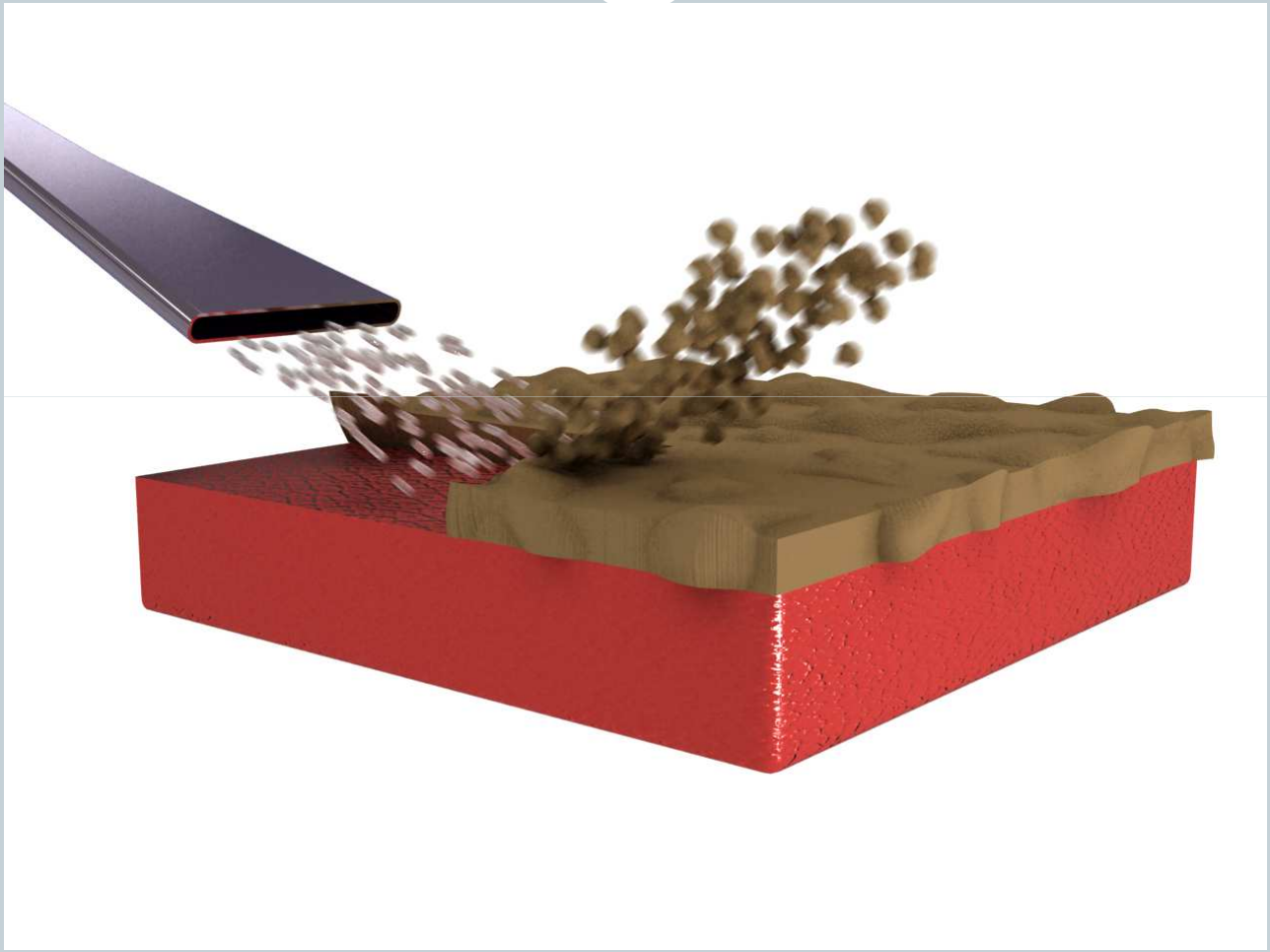
- Dry ice blasting has been used for a number of years for industrial cleaning purposes
- The potential for removing soot from smoke damaged materials has been investigated by Randy Silverman at the University of Utah in the United States
- This project will investigate the effectiveness of dry ice for the removal of surface dirt from library and archive materials

COMMERCIAL FOCUS

- The use of dry ice would provide an efficient and effective approach that could be made available on a commercial basis
- It would also have applications for cleaning flood damaged materials

DRY ICE CLEANING PROCESS

- Dry ice is solid carbon dioxide that is broken down to small particles
- The particles are propelled towards the surface of the material to be cleaned
- As the dry ice hits the surface dirt the thermal shock causes it to crack
- At the same time it sublimates i.e. passes from a solid to a gas
- The gas enters the cracked surface and expands
- This causes the dirt to become detached from the surface of the material



RESEARCH AIMS

The research aims to evaluate:

- The effectiveness of the cleaning process
- Any changes in the materials tested

METHODOLOGY

The research will evaluate:

- The impact of different diameters of dry ice particle
- The impact of different rates of propulsion
- The removal of three types of surface dirt was investigated as defined in ASTM F1284 – 09 Standard Test Method for Evaluating Carpet Embedded Dirt Removal Effectiveness of Residential Central Vacuum Cleaning Systems
- The change in surface morphology and elemental materials will be evaluated before and after cleaning using Scanning Electron Microscopy (SEM) and Energy Dispersive Analysis (EDX)

OUTCOMES & FUTURE DEVELOPMENTS

- It is anticipated that by the end of the project the efficiency and effectiveness of dry ice for the removal of surface dirt from three types of library and archive materials will have been demonstrated.
- It is hoped that the pilot will contribute to a larger funding application to a research council
- In the long term it would be interesting to investigate the commercial applications of the process

CONCLUSIONS

Both projects demonstrate:

- The benefits of cross discipline, cross school research
- That research is not entirely dependant on huge research council grants
- Small pilot projects can often make valuable contributions to subsequent applications to research councils