

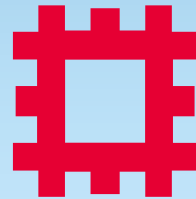


English Heritage

The Effect of Air Tightness on RH Control

David Thickett

Collections Conservation Team

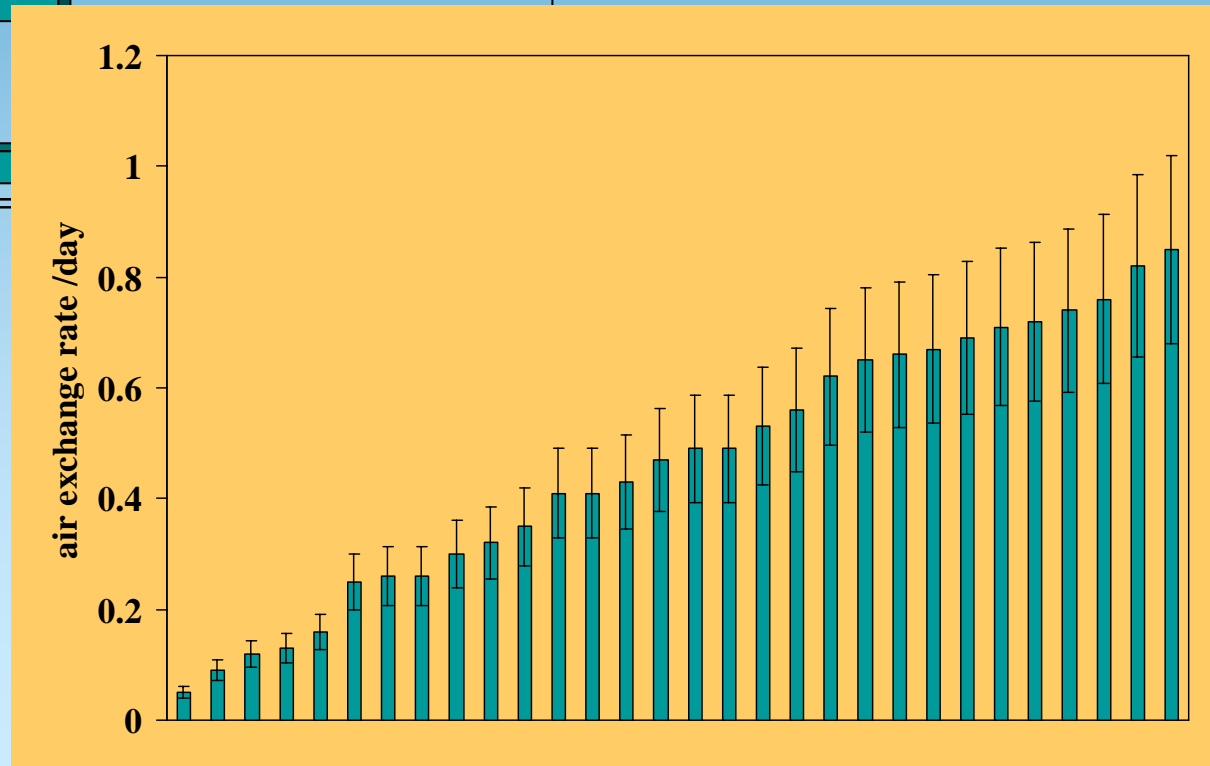
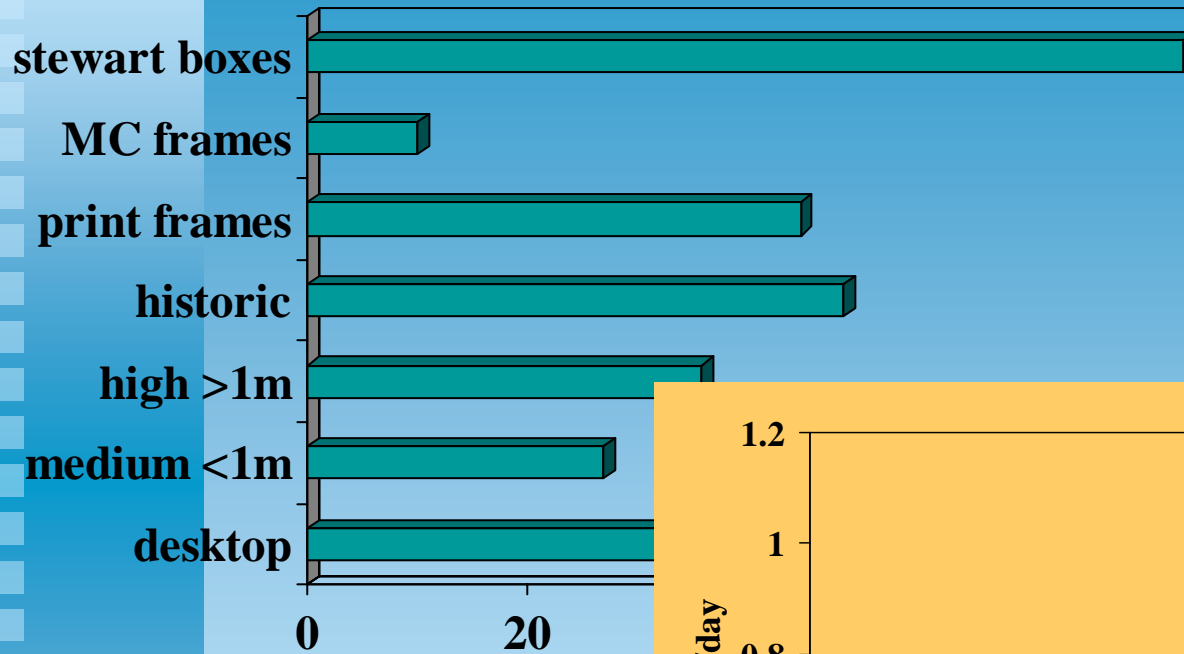


ENGLISH HERITAGE



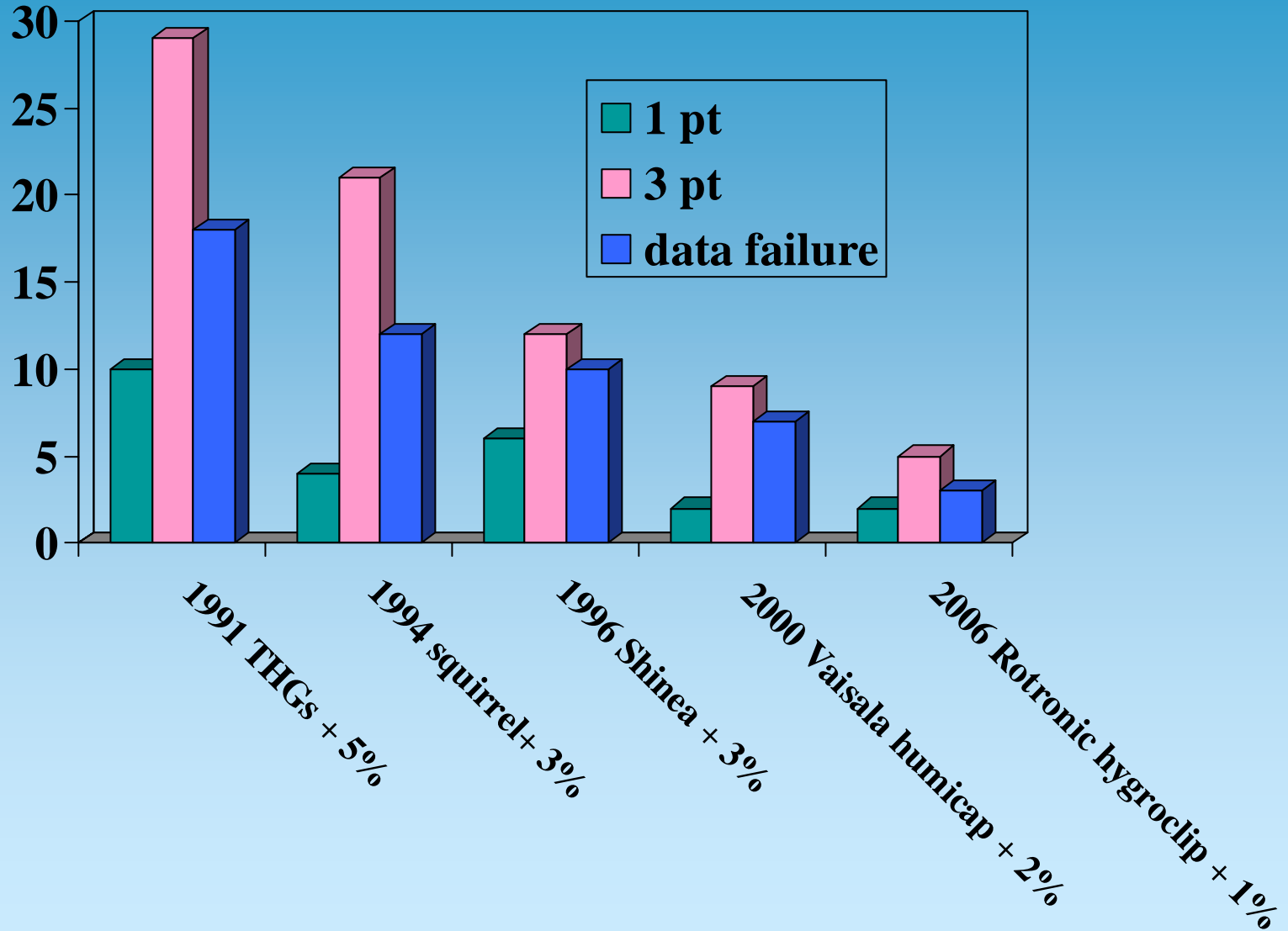
English Heritage

AER Measurements





RH measurement





Thomsen (1977)

$$t_{1/2} = \frac{4MB}{N}$$

$t_{1/2}$ is the hygrometric half life (days)

M is the loading of silica gel in the box (0.1kg/m³)

B is the specific moisture reservoir of silica gel (8 g/kg/%)

N is air exchange rate (0.35 and 0.65 /day)

Thermal Equilibrium between enclosure and room
Perfect and rapid mixing in enclosure



Weintraub and Tetrault (2003)

$$t_{RH} = \frac{MFB_H}{C_{eq}DN}$$

t_{RH} is time to reach a specified RH (days)

F is targeted range of RH fluctuation (irrelevant for this application but taken to be 16 %)

B_H is specific moisture reservoir corrected for hysteresis (this effect is negligible for regular silica gel below 30% RH)

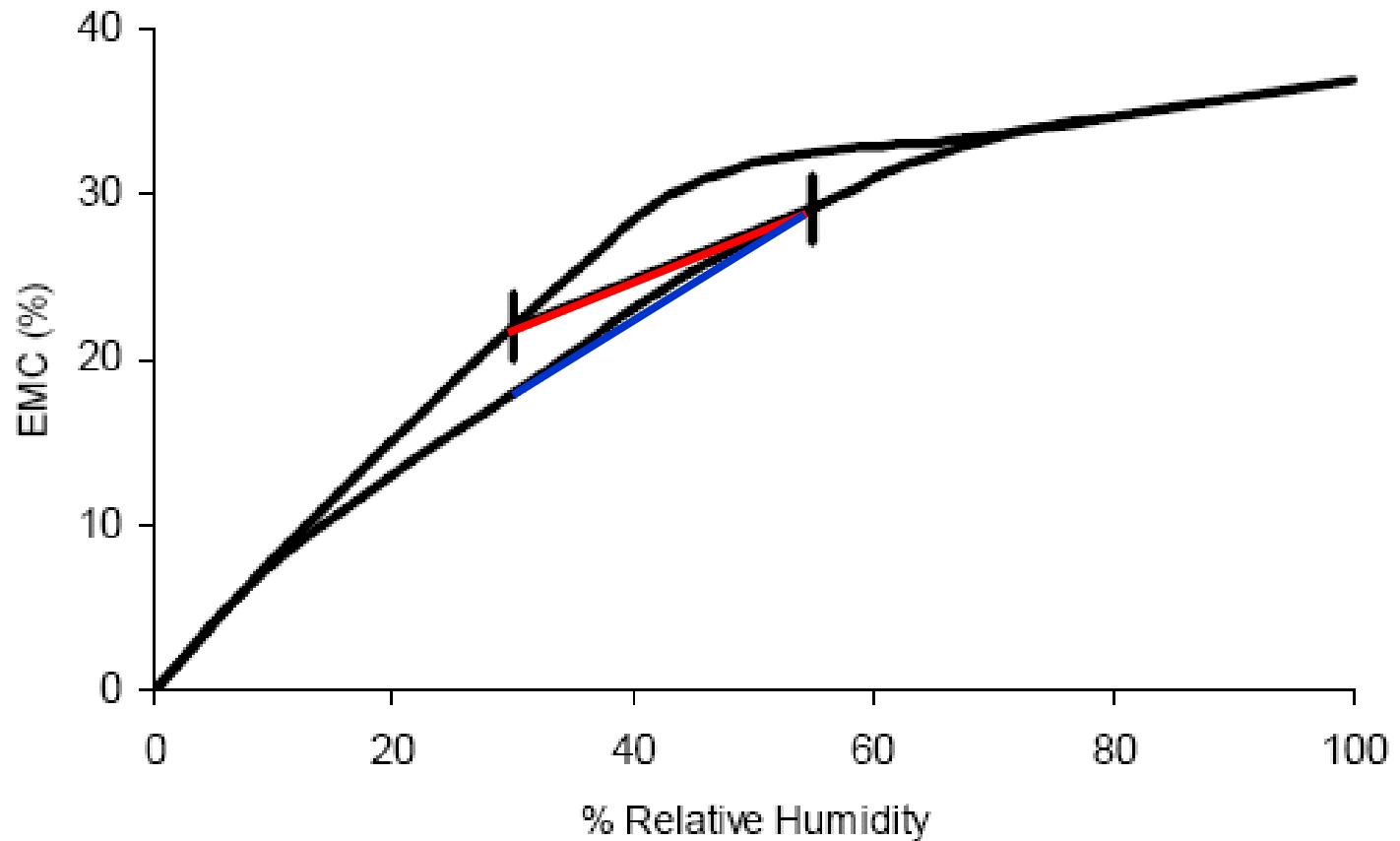
C_{eq} is equilibrium concentration of water vapour (calculated g/m^3)

D is decimal difference between external RH and chamber (0.59)

Perfect and rapid mixing in enclosure



EMC / RH Isotherm for Regular Density Silica





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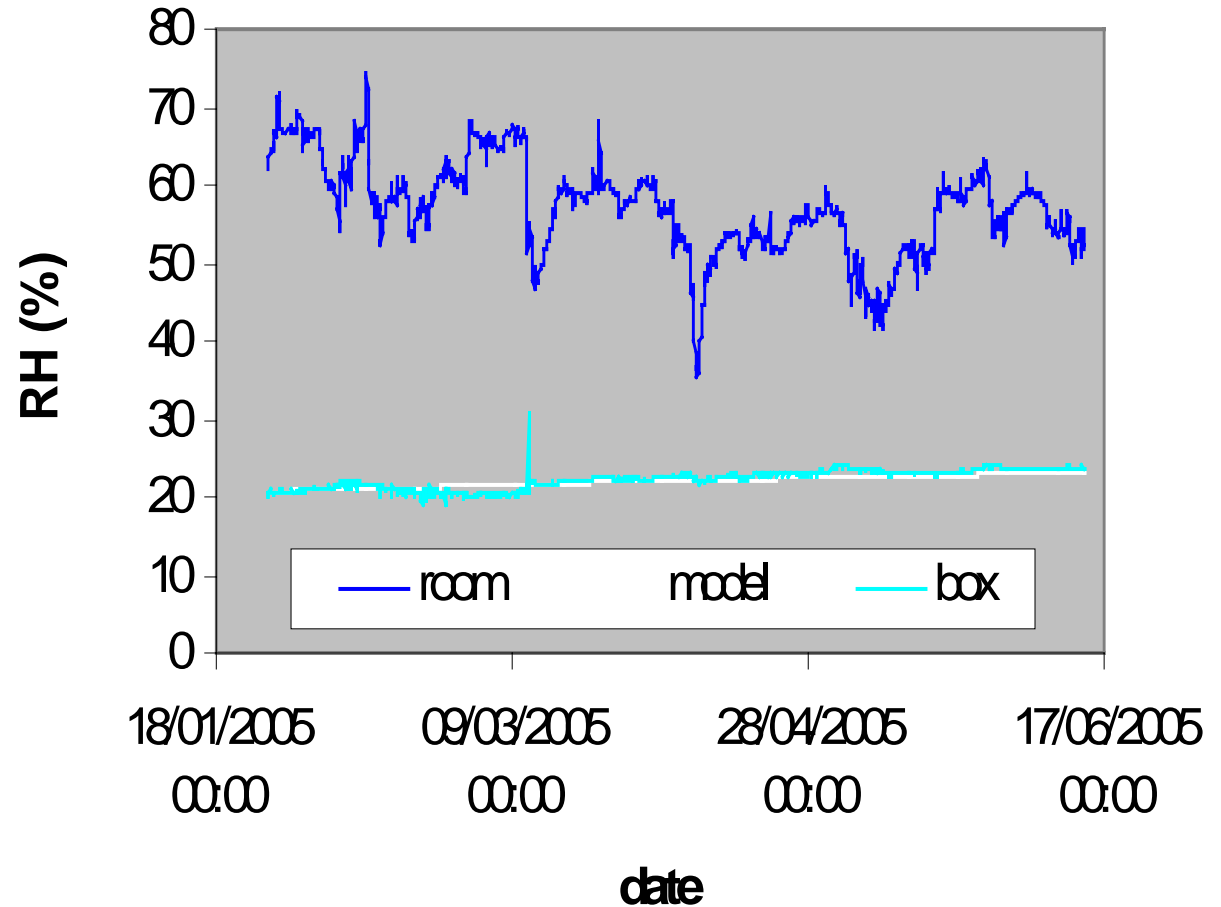
Dryer than Room





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Stewart Boxes for Archaeological Metals



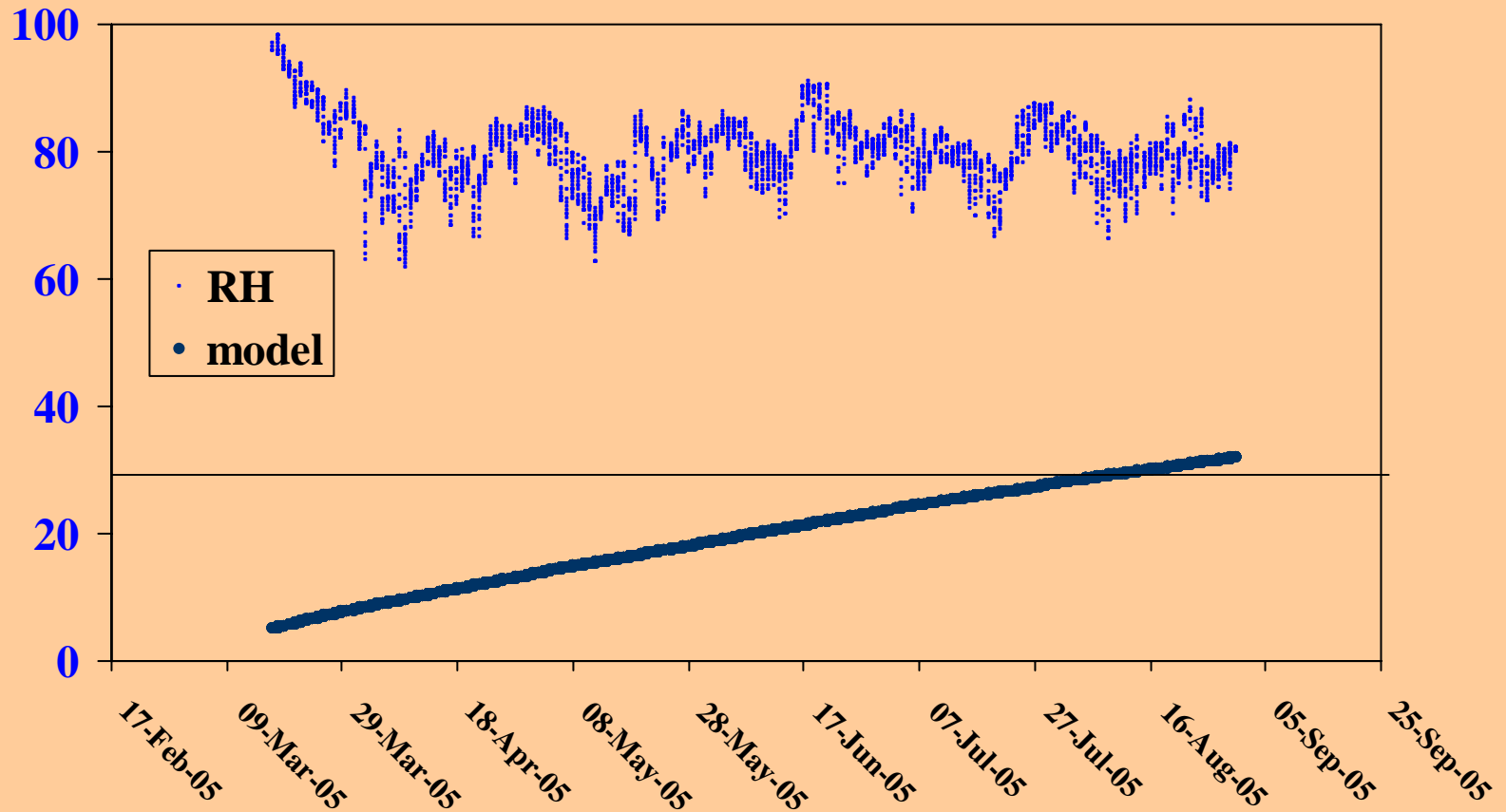
Thickett & Odlyha, *Conservation Arch Materials*, 2007



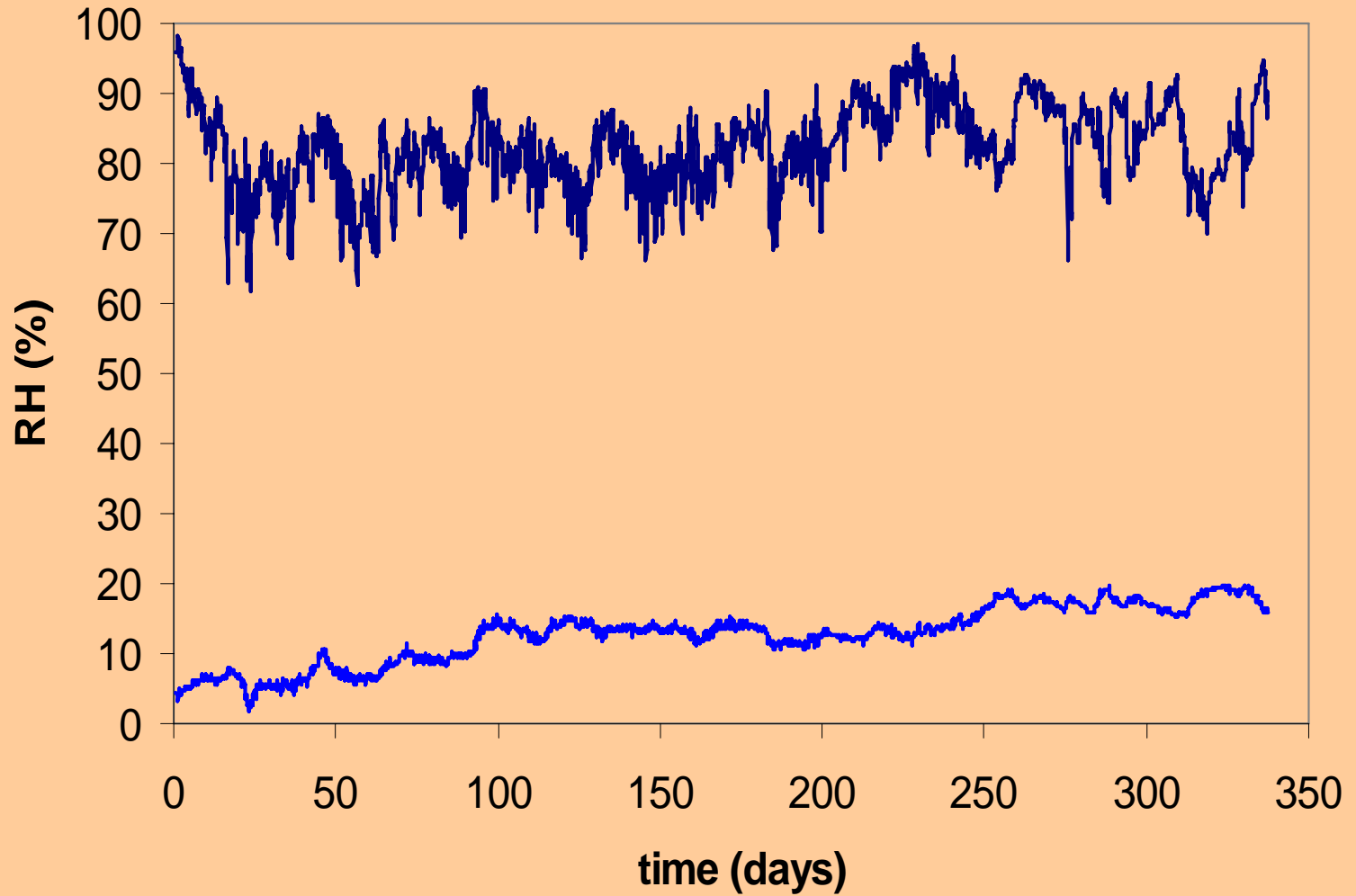
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Porchester





$t_{1/2} = 4MB/n$
 $M = 10\text{kg/m}^3, B = 8, t_{1/2} = 187\text{days}$





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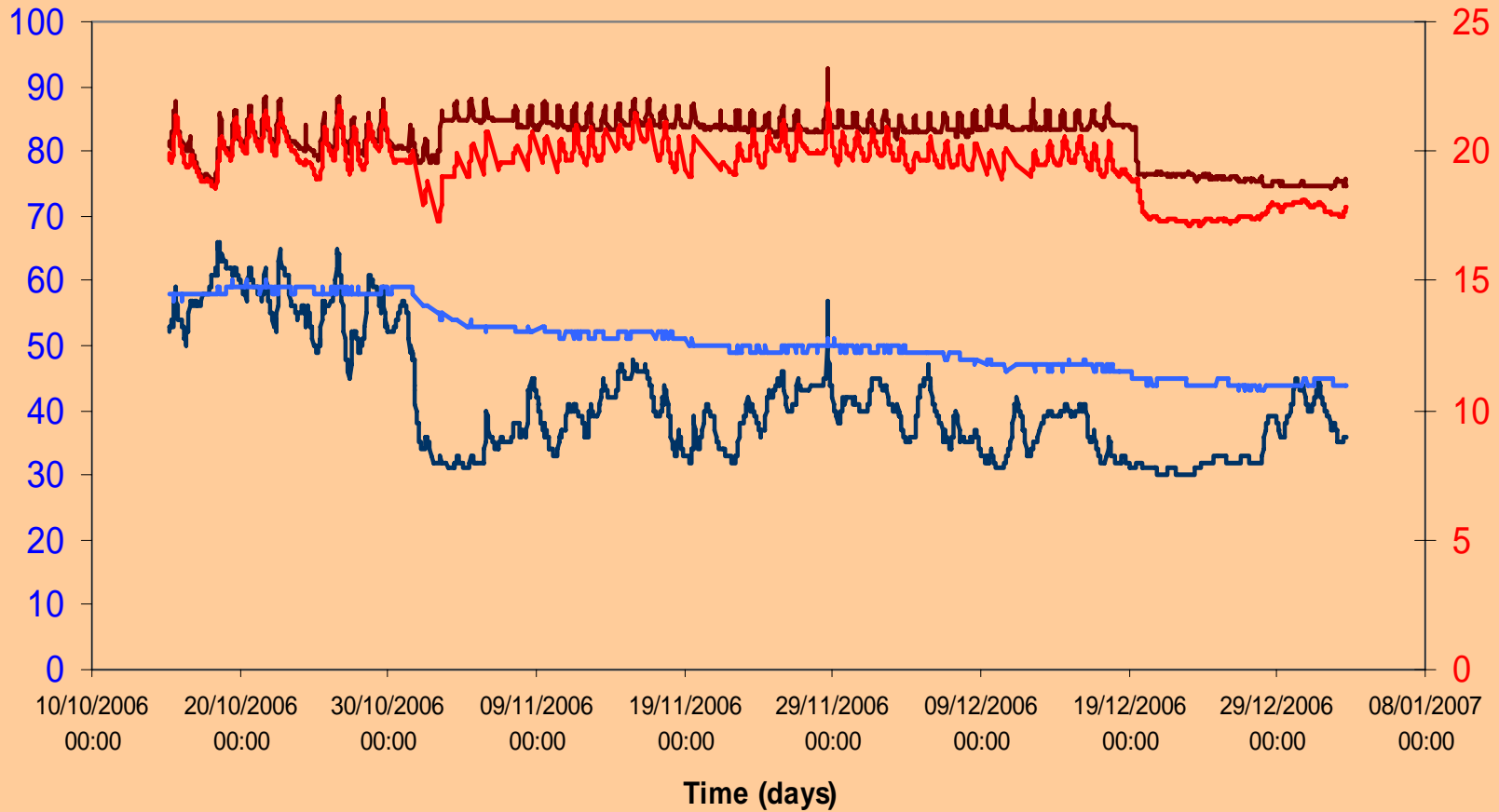
Wetter than Room





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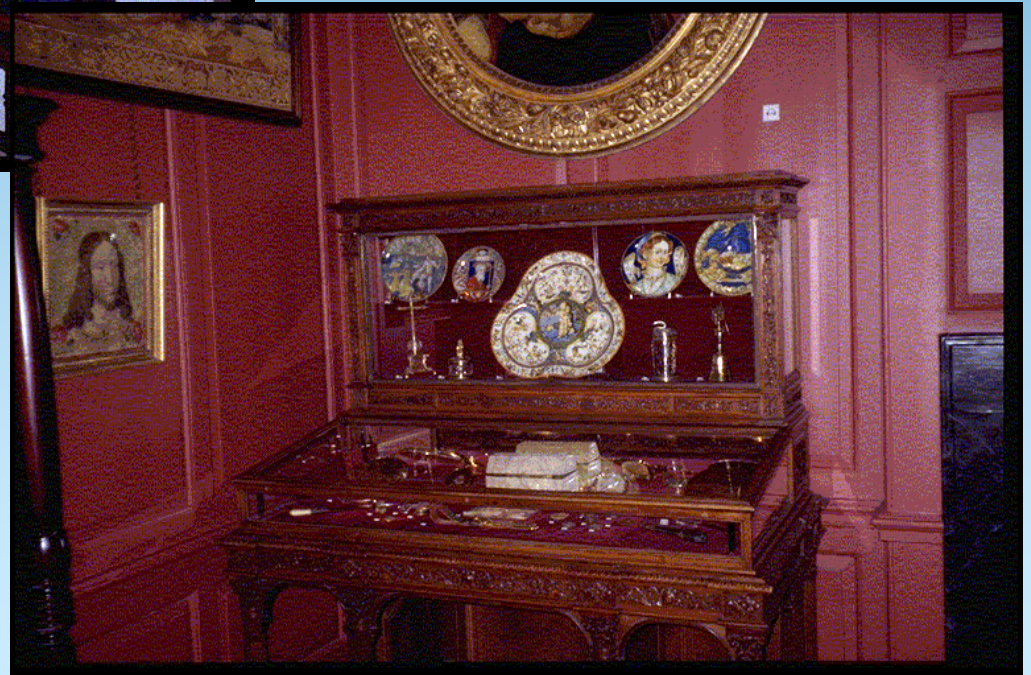
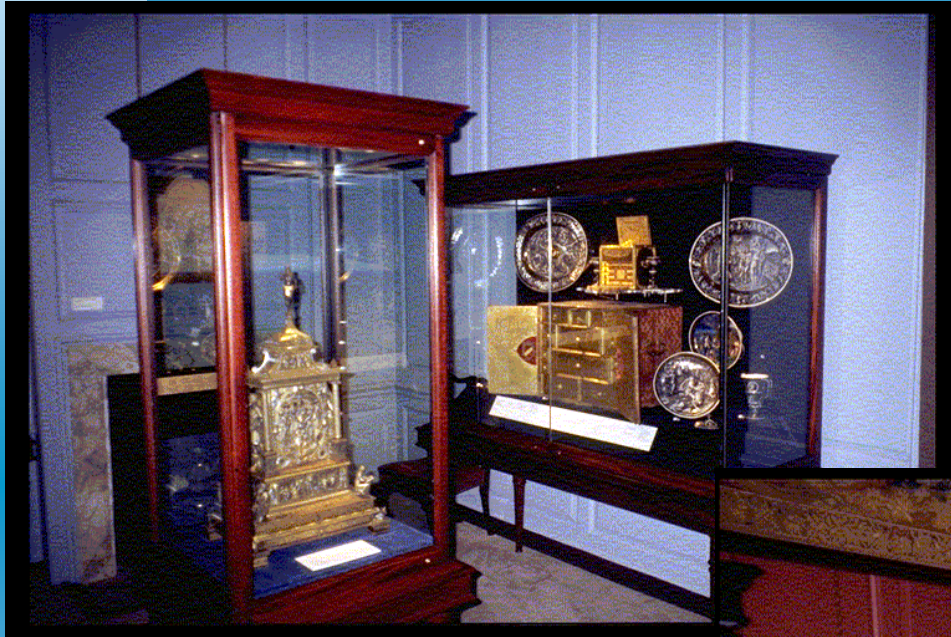
Down House, London





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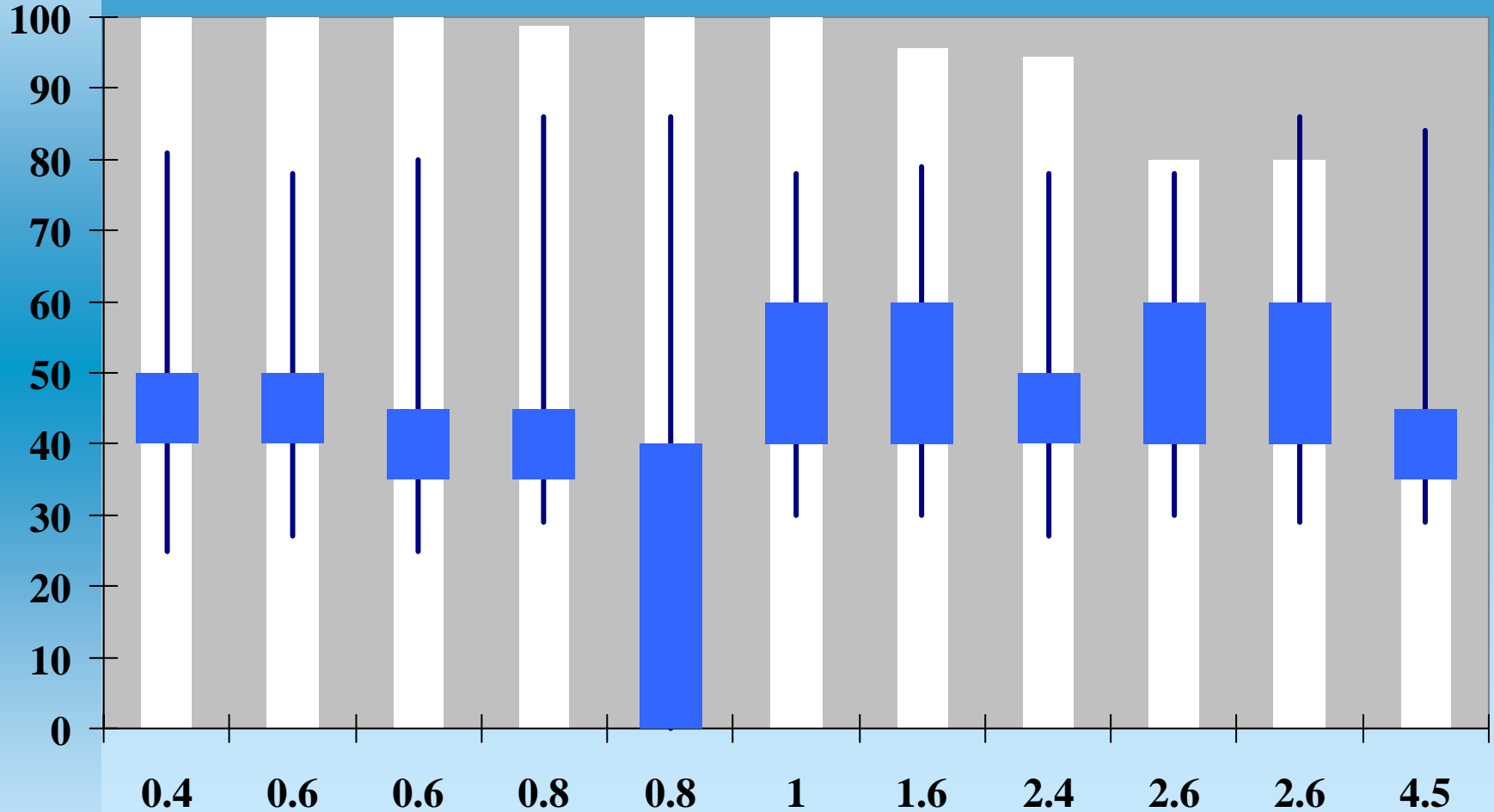
Above and Below Room





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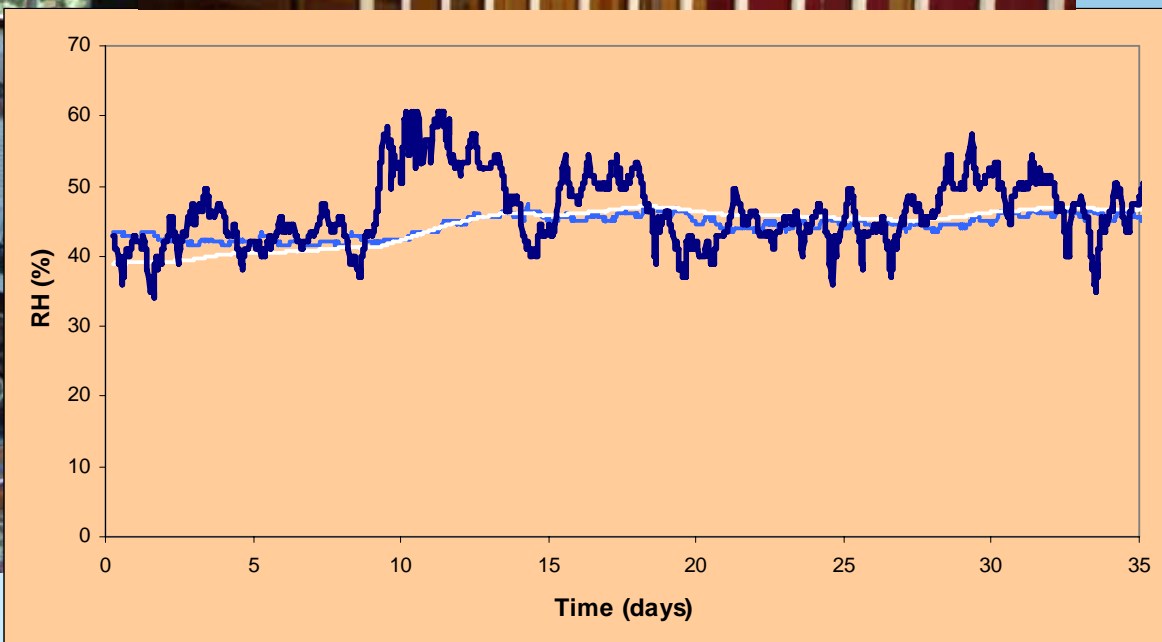
Werner Collection, Rangers House London



Thickett et al, *Conservator*, 2005



English Heritage





Mechanical Conditioning

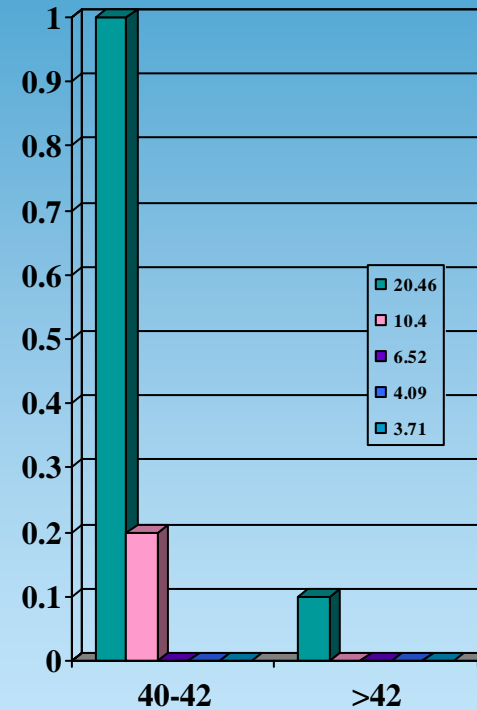
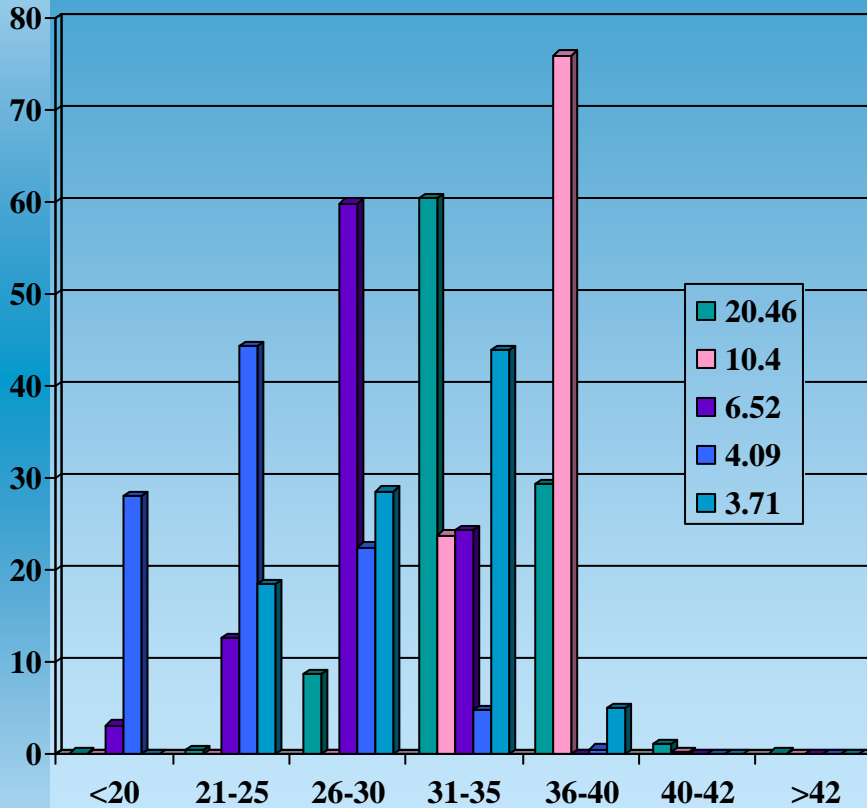
- Dehumidifiers
- Humidifiers
- Mixed
- Flow Through, Hahn RK2,
- Recirculation, Miniclimate



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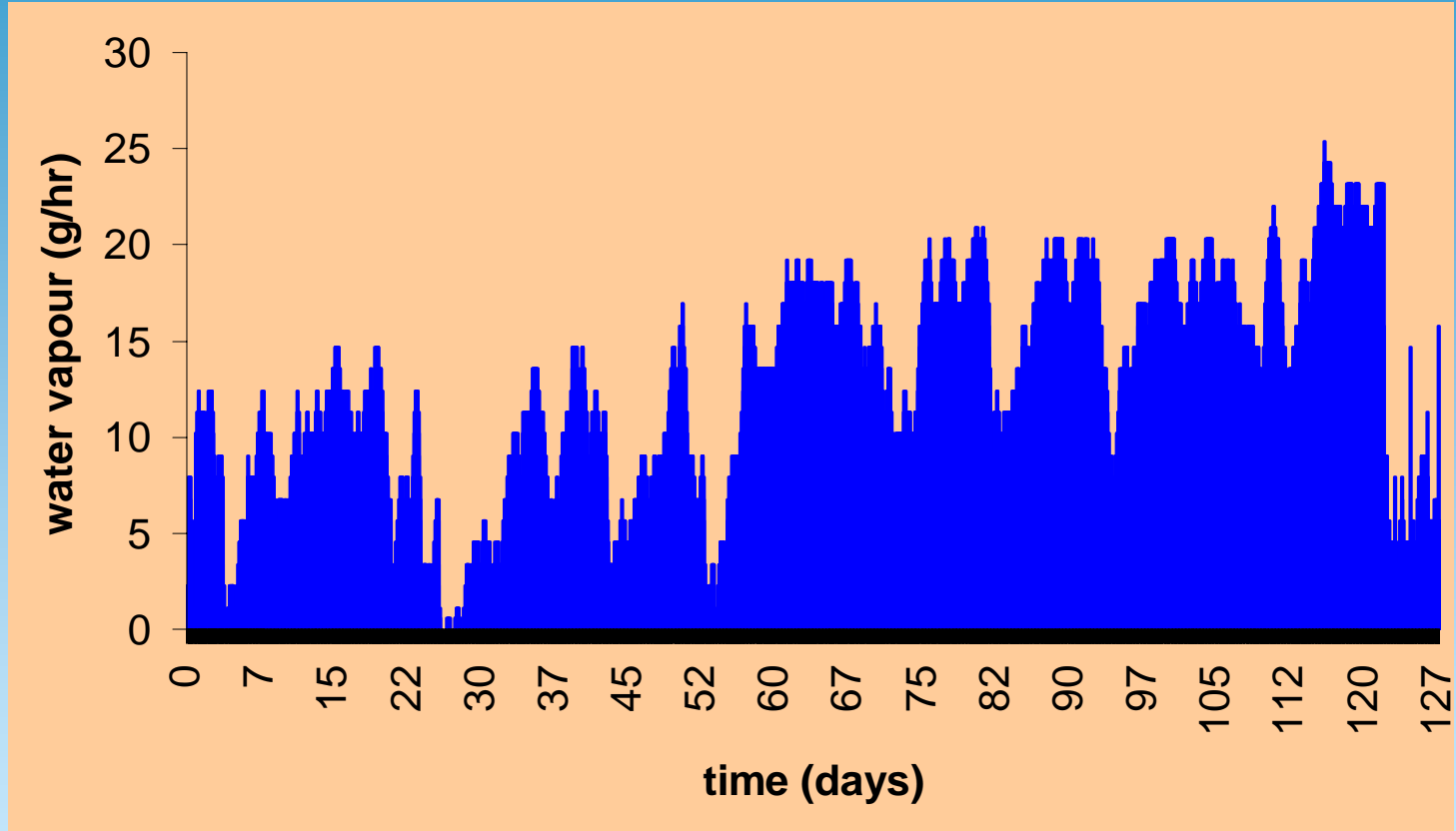
Dehumidifier Performance

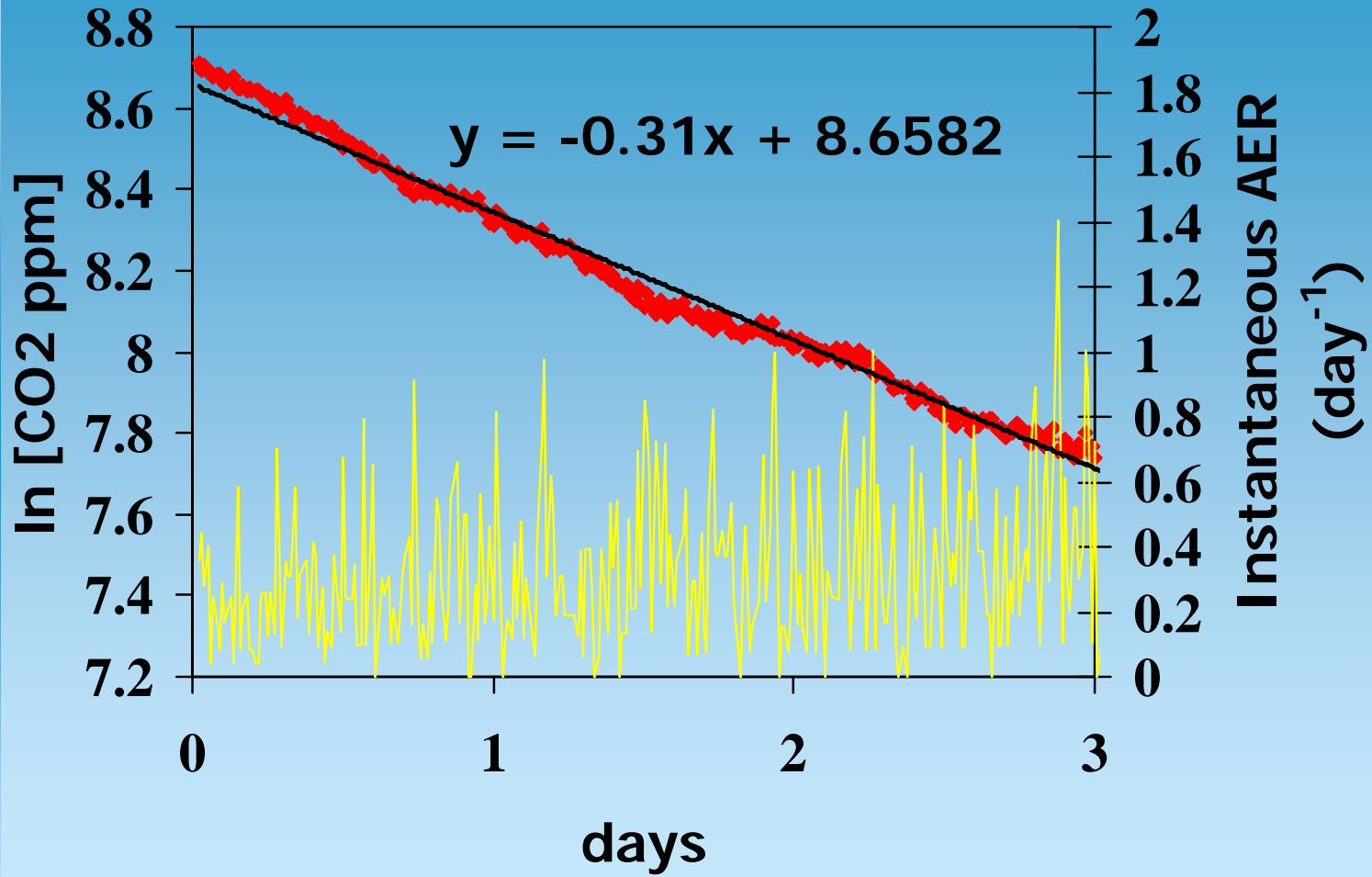
Bronzes, 42%





Dehumidifier Specification

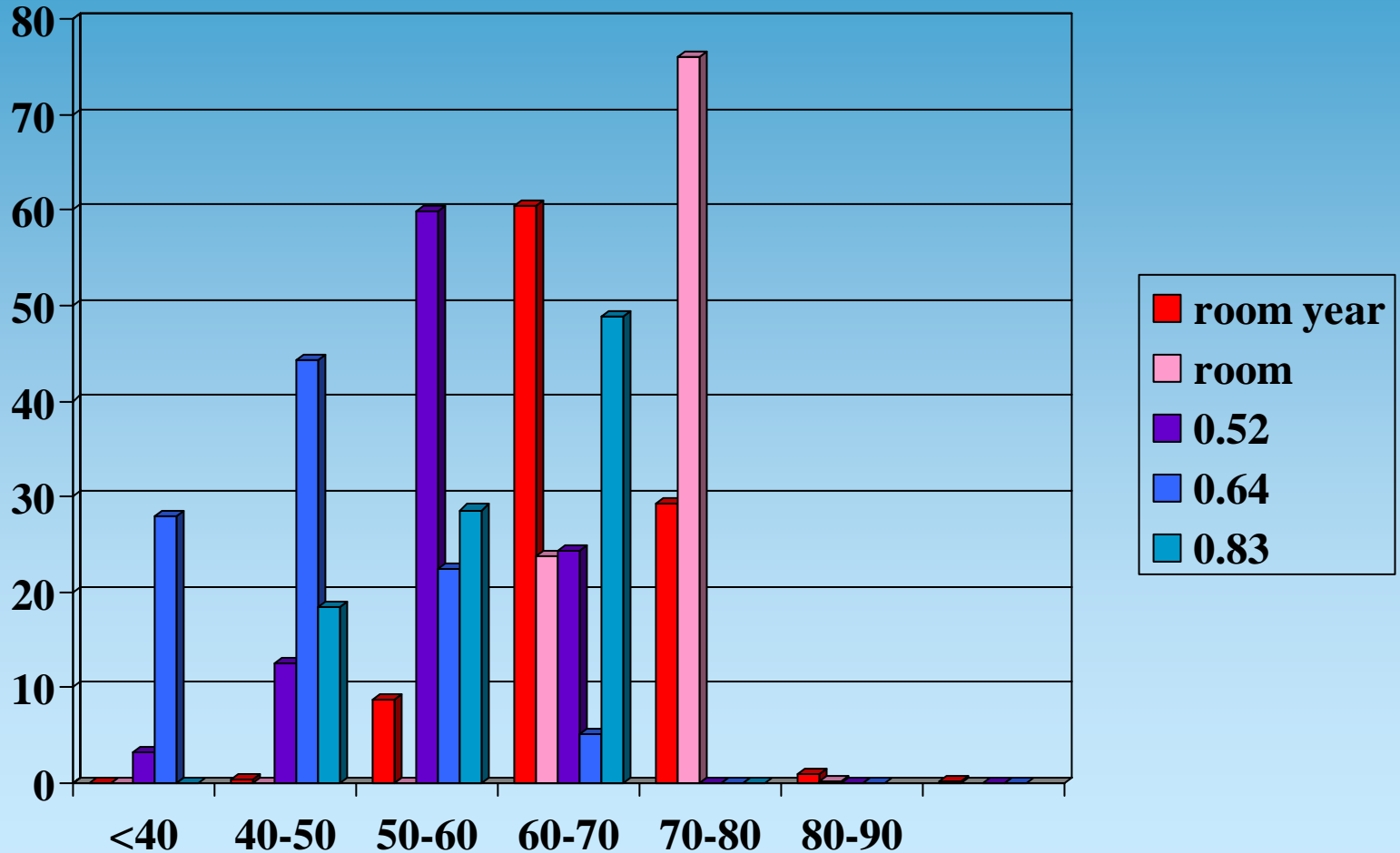






Dehumidifier Performance

Bones, 70%

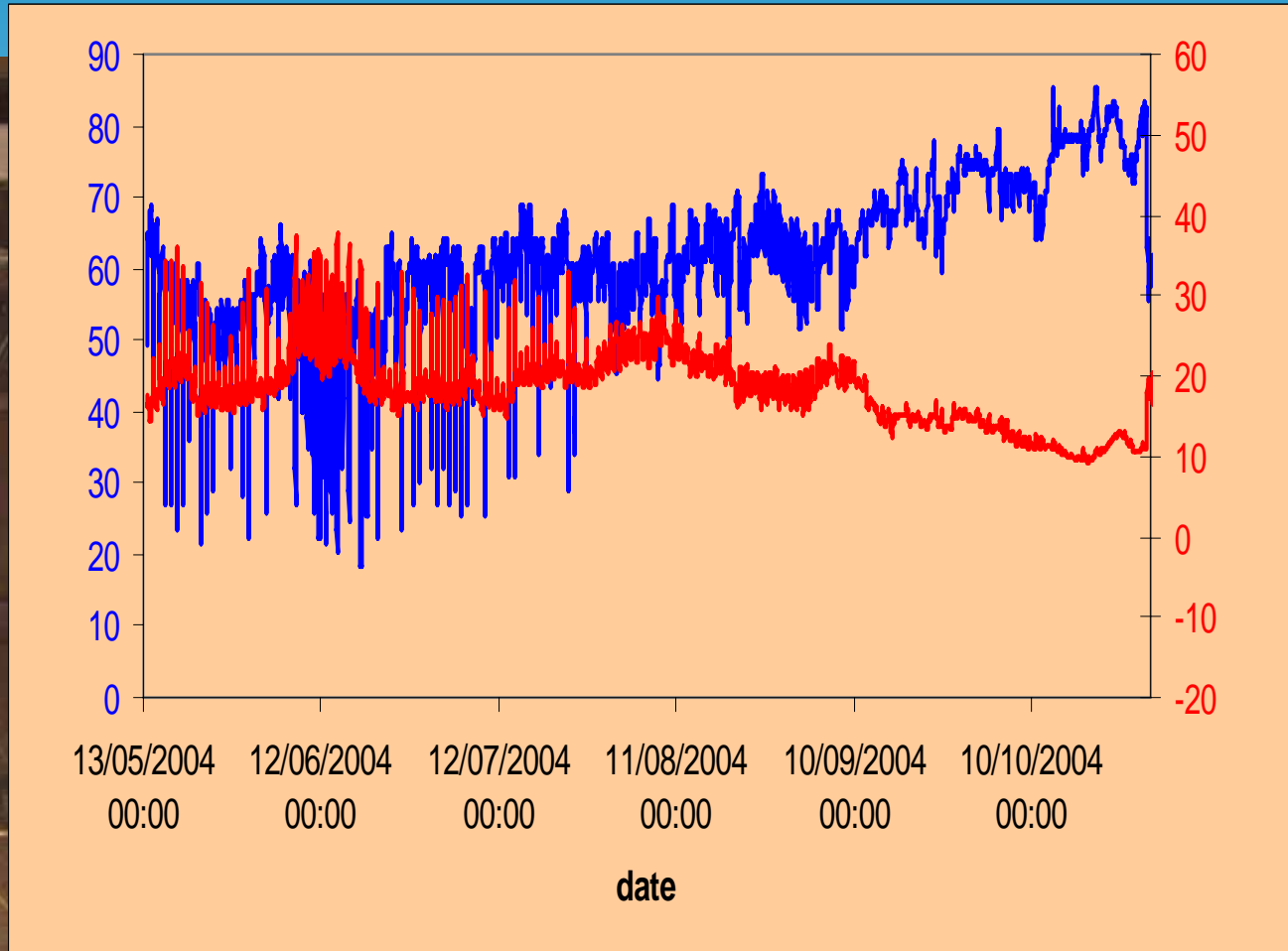
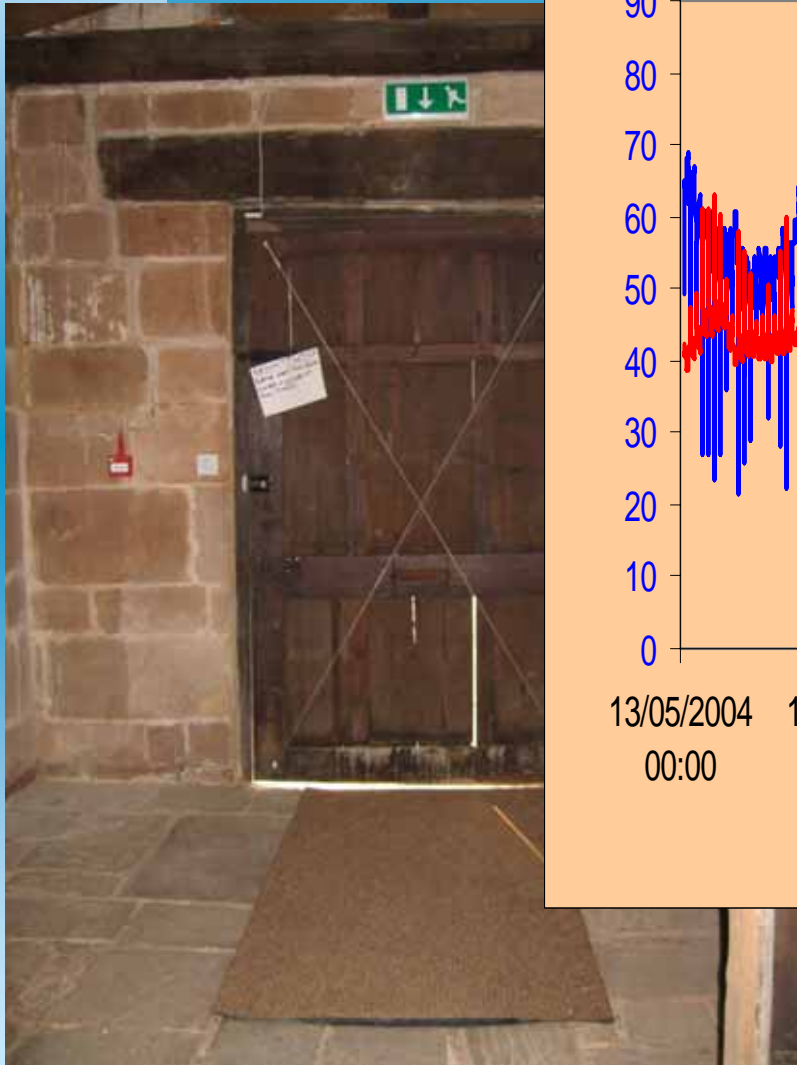






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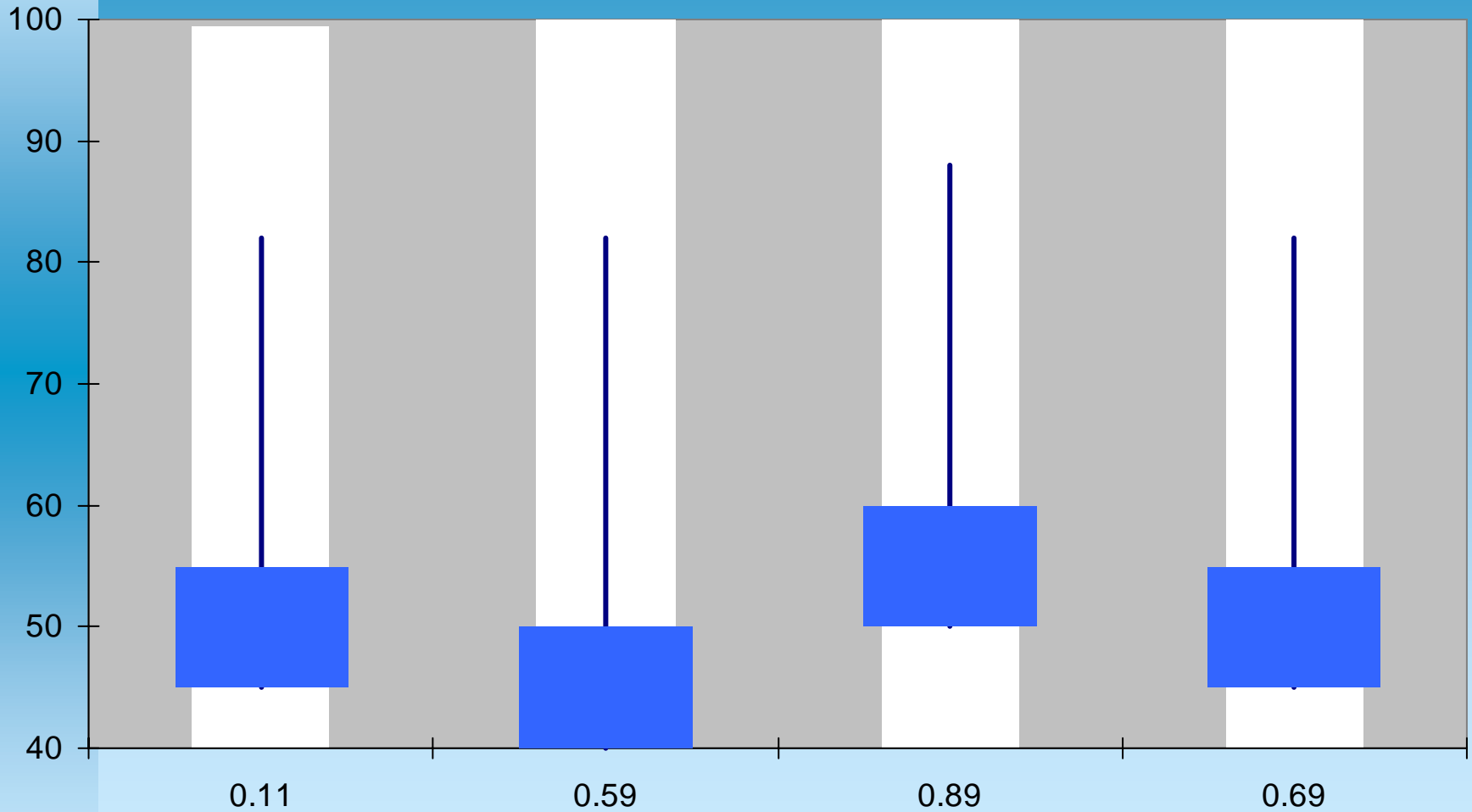
Kenilworth Environment





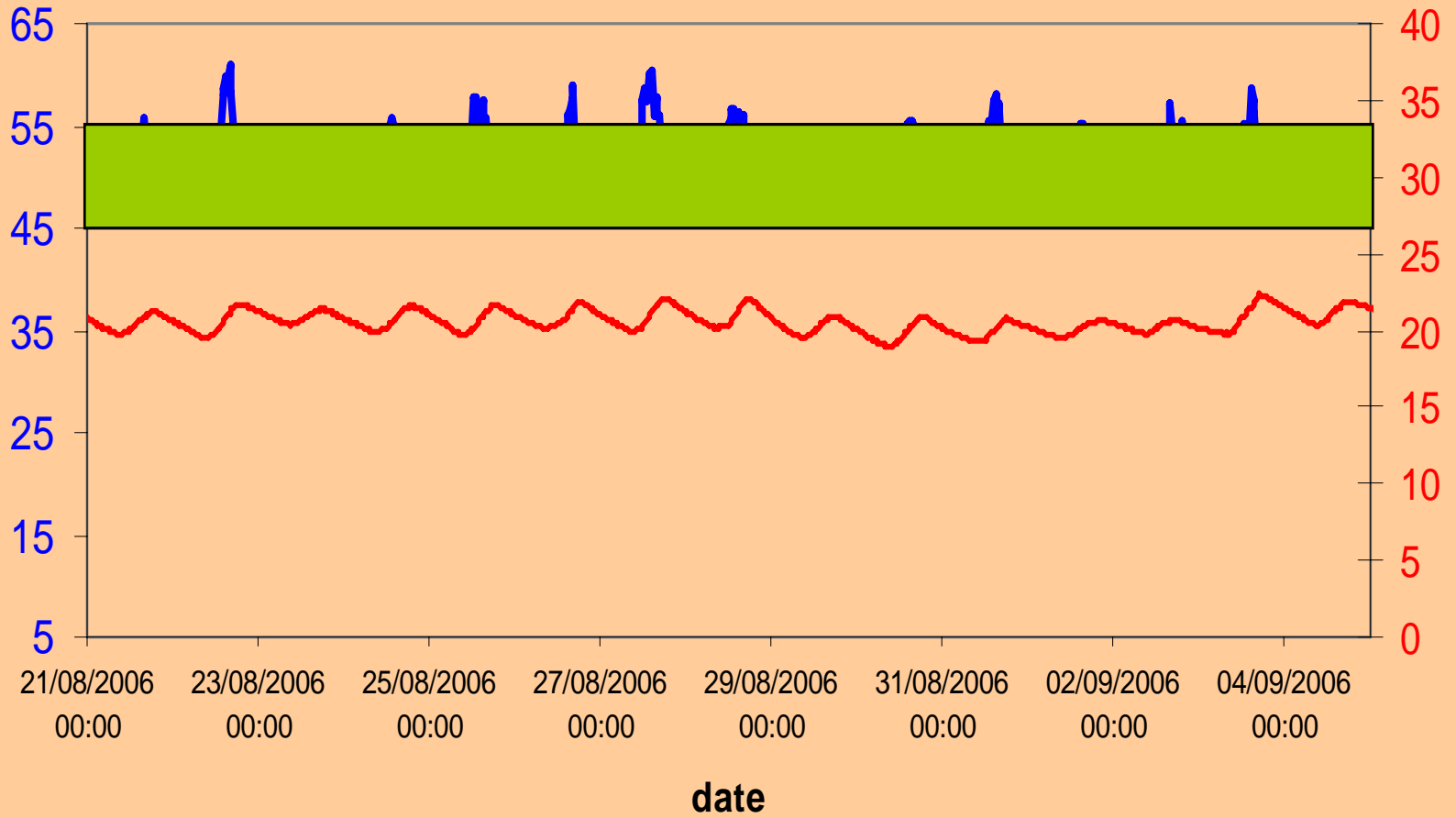
English Heritage

Conditioning Performance





Tapestry Case RH





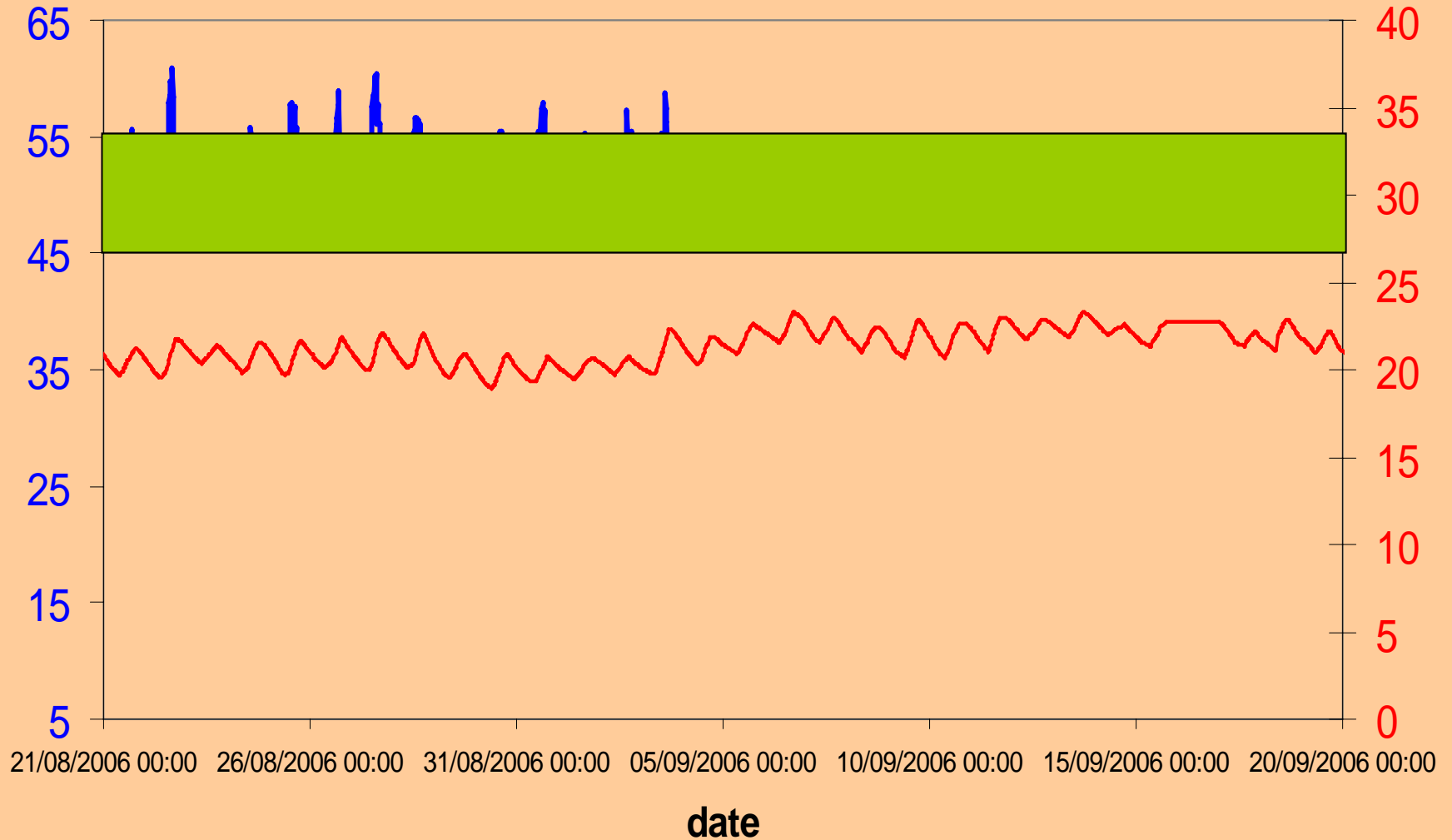
English Heritage





English Heritage

Tapestry Case RH



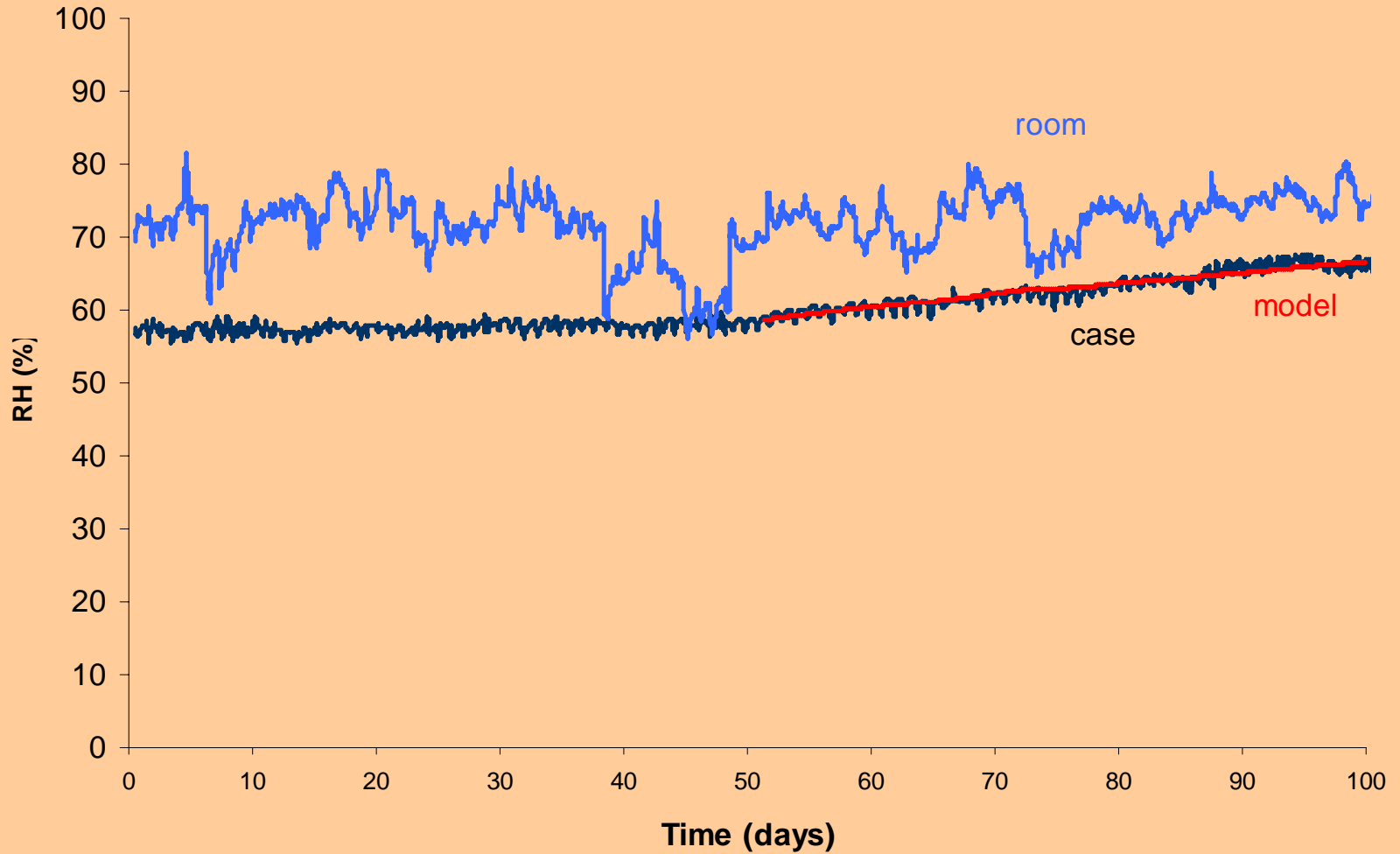


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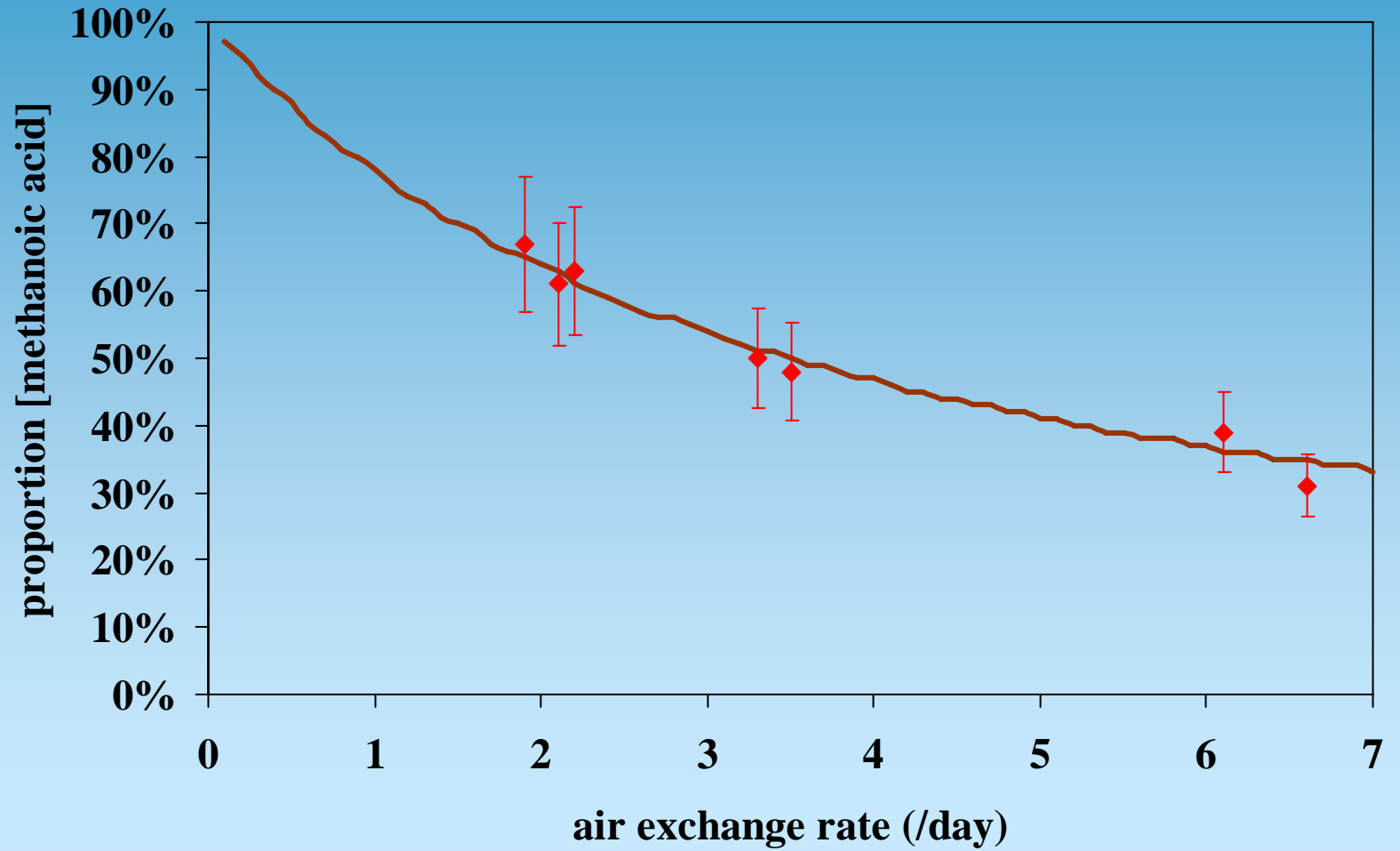
Conditioning Failure





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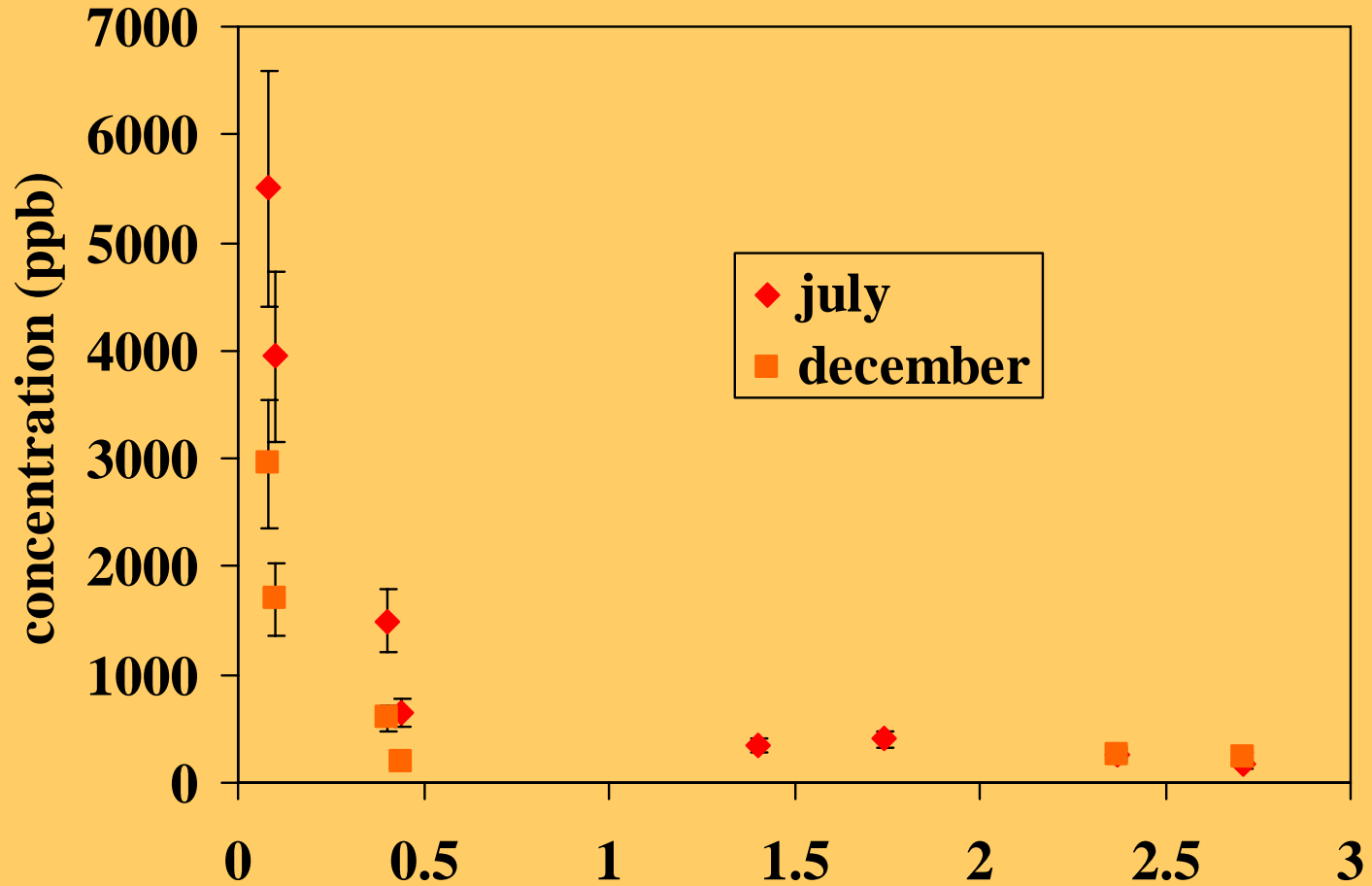








Ethanoic acid





Conclusions

- Modelling internal RHs fairly well, well enough
 - Temperature effects
 - Wood
- Predict performance of cases
- Specify AER required, cost implications
- Methanoic acid, equation works well
- Ethanoic (sealed MDF), apparent ‘threshold’
~0.5day⁻¹



Acknowledgements

- Philip Fletcher, British Museum
- Andrew Calver, Museum of London
- Sarah Lambarth, ICON/HLF
- University of Strathclyde