Monitoring and modelling of microenvironment inside storage boxes

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Introduction

In heritage institutions, boxes are valuable tool for protection of artefacts against temperature and relative humidity fluctuations.[1] However, microenvironmental conditions inside archival boxes can cause deterioration of heritage material. Therefore, it is important to monitor temperature and relative humidity levels both outside and inside of box, which was the aim of this research. In addition, calculated air exchange rates and model plots were used to investigate what processes cause fluctuations of RH in boxes.[2,3]

Materials and methods

Cardboard, Solander and plastic box were used in preliminary experiment (**Fig. 1**). Monitoring was carried out for 2 weeks and data was collected every minute. Boxes were exposed to changing external environments to see how they influence microenvironment in box. Boxes were first empty and then filled with print paper.

From humidity values air exchange rates for each box were calculated and model plots were created using AER and humidity values.[4]

Fig 1. Boxes used in the monitoring experiment

Results and discussion

While temperature fluctuations for all boxes followed external fluctuations, RH plots were different, meaning that each box behaved differently during changes in external humidity.

Cardboard box showed biggest fluctuations in humidity levels (**Fig. 2**), meaning it had lowest buffering properties.

Paper material has potential buffering effect on humidity inside boxes, because boxes showed smaller fluctuations when filled with paper.
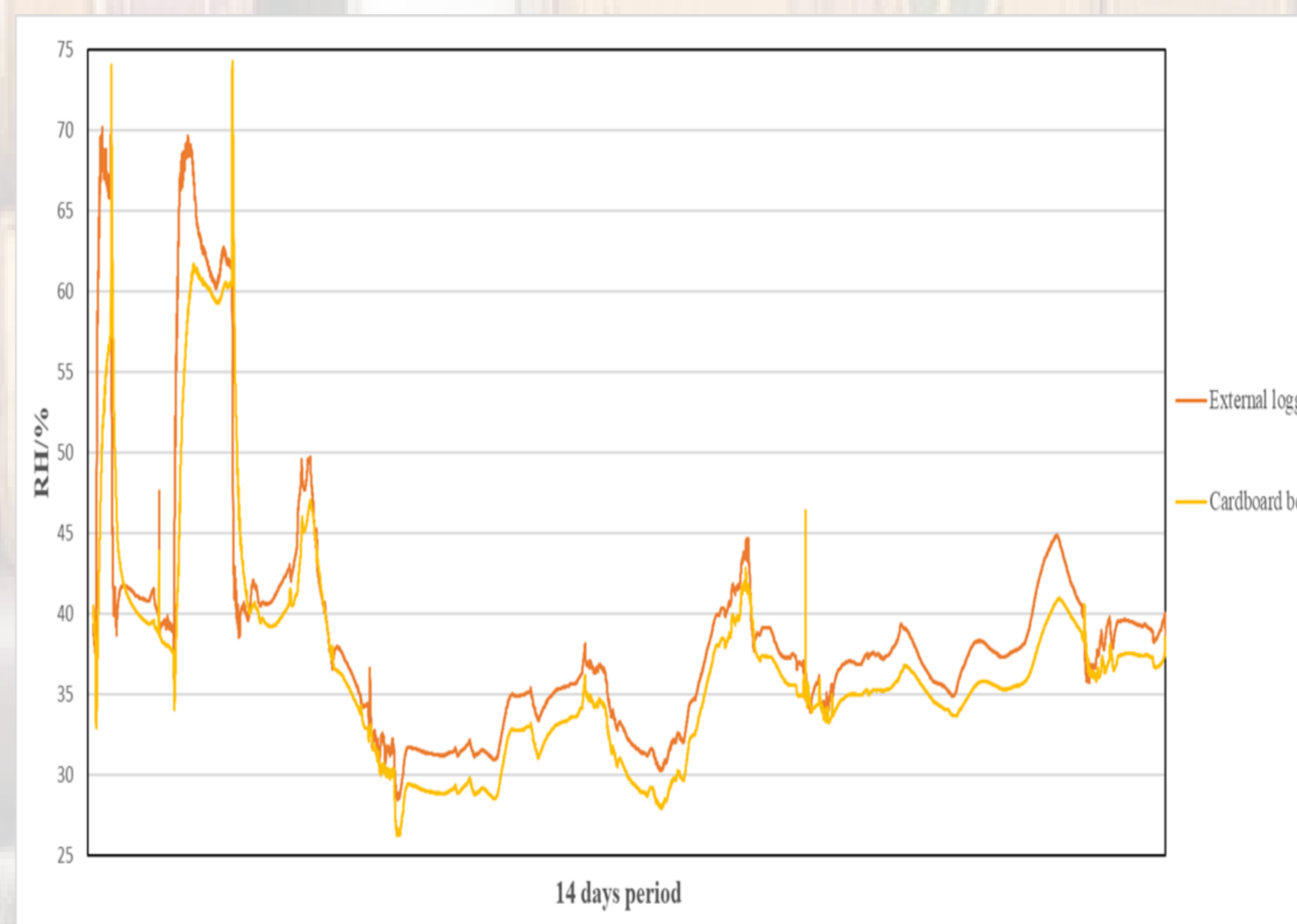

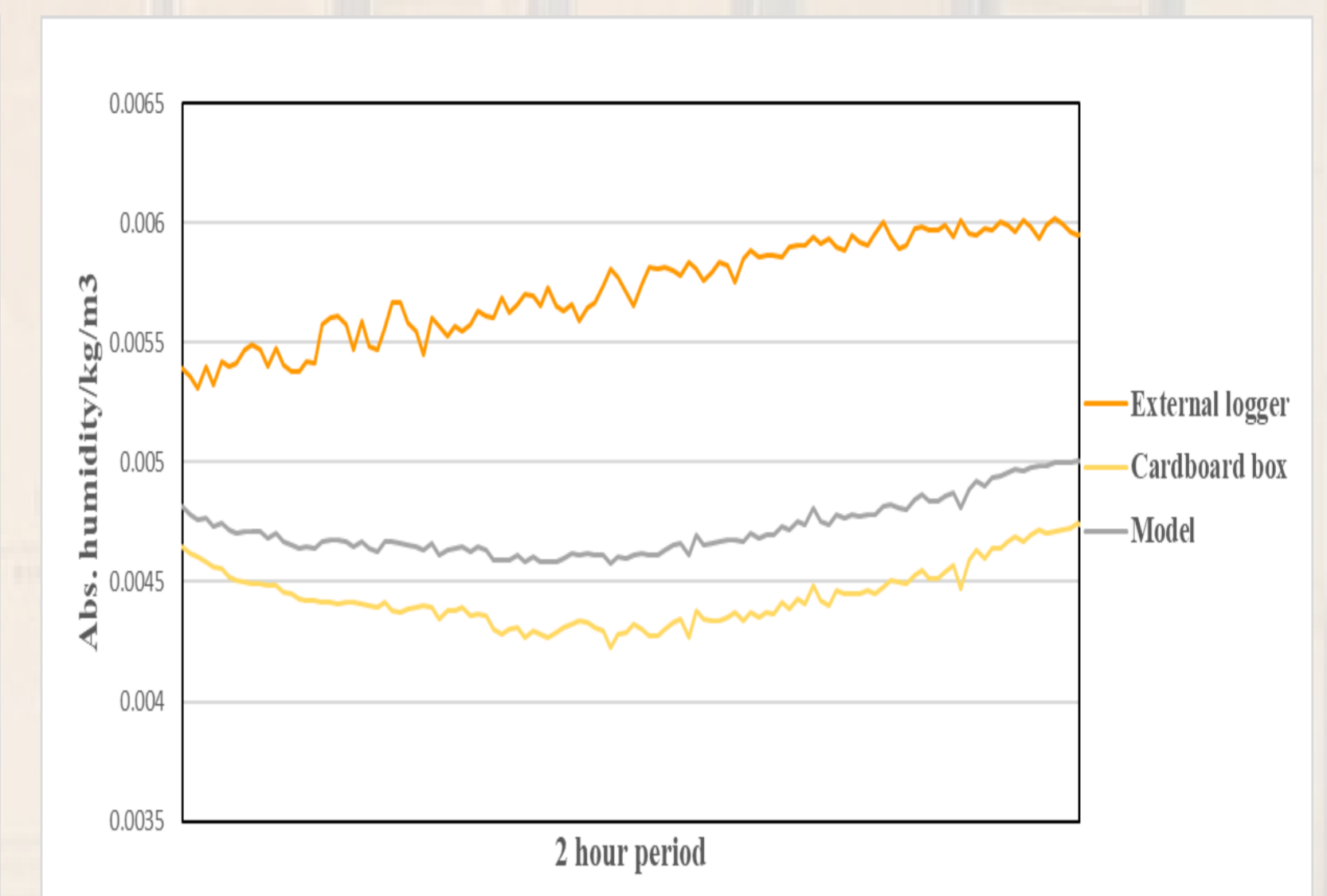**Fig. 2.** Time dependent RH plots for external logger and cardboard boxes

Fig. 3. Time dependent absolute humidity plots for external logger, cardboard box experimental and model

Cardboard box had highest AER value (13.2 per hour) of all boxes, possibly because of its holes. Model plots had good fit with RH experimental plots, except for cardboard box (**Fig. 3**). Therefore, fluctuations in cardboard box are caused by other processes, not only air exchange.[2]

Future research and benefits

In future research, microenvironmental monitoring and modelling on collection of boxes made of paperboards with different chemical properties and similar sizes will be conducted. Main focus is going to be on what influences box microenvironment more: air exchange or absorption/desorption of water in box material, and in what conditions?

Benefits of this research are: understanding how box material behaves in different environments, implementation of new methodologies and materials and improvement of preventive conservation policies.

Literature

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