University of BRISTOL

Bristol Composites Institute

Mycelium Composites: A Sustainable Construction Material?

Stefania Akromah (CDT 21)

Supervised by: Prof. S.J. Eichhorn, Dr. N. Chandarana, Dr. J. Rowlandson

UKRI Engineering and Physical Sciences Research Council

University of BRISTOL

EPSRC Centre for Doctoral Training in Composites Science, Engineering and Manufacturing

BCI Symposium

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Presentation Outline

- What is a mycelium composite?
- Why MCs?
- Are MCs eco-friendly?
- Are MCs practical?
- Conclusions and future work

What is a mycelium composite?

Mycelium composites (MC) can be defined as “mushroom-based composites”

(a) Acoustic and thermal insulation panel, Mogu™

(b) Chair, “the living room project” by M.T. Sisman & B. MCClellan

(d) Floor Tiles, Mogu™

(c) Packaging (left) and core (right), Grown Bio™

Fig. 1 *Some MC applications*

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b. https://www.designboom.com/design/mushroom-furniture-by-merjan-tara-sisman-brian-mcclellan/
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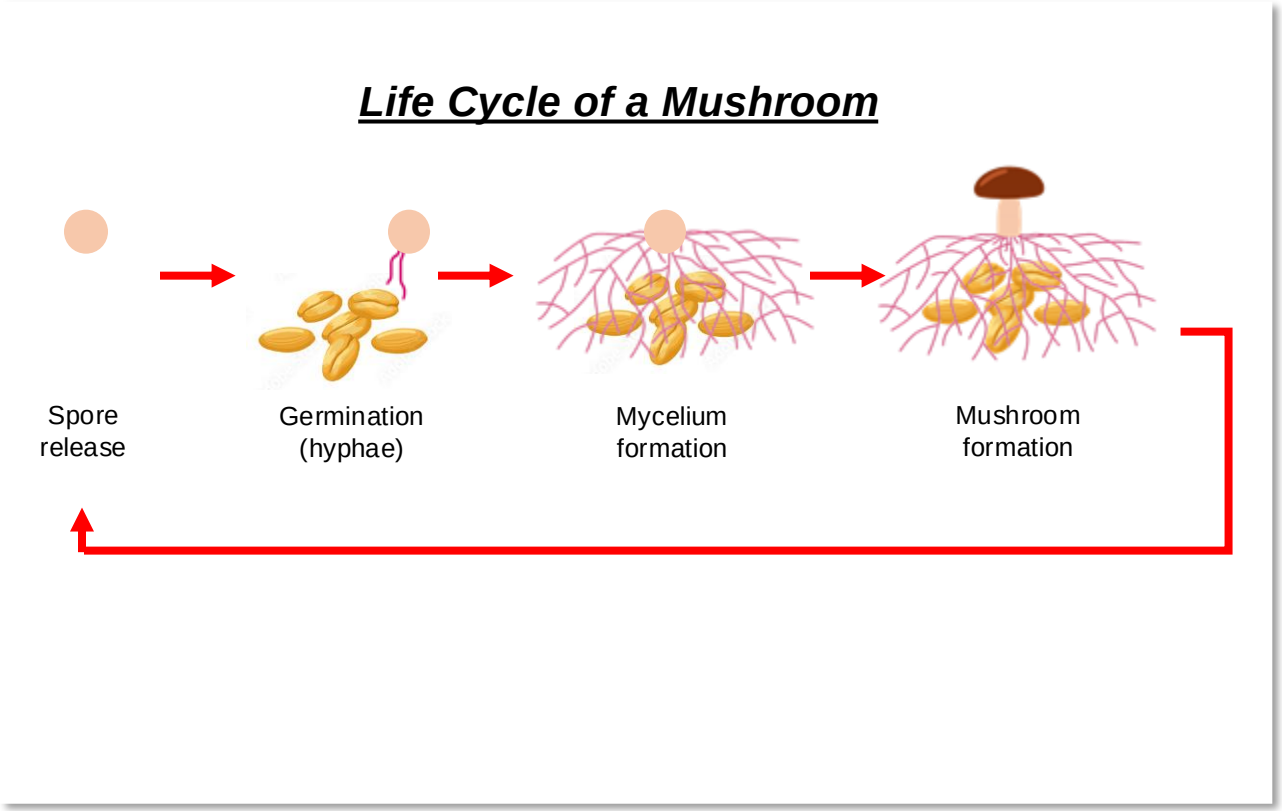

(a) Acoustic and thermal insulation panel, Mogu™

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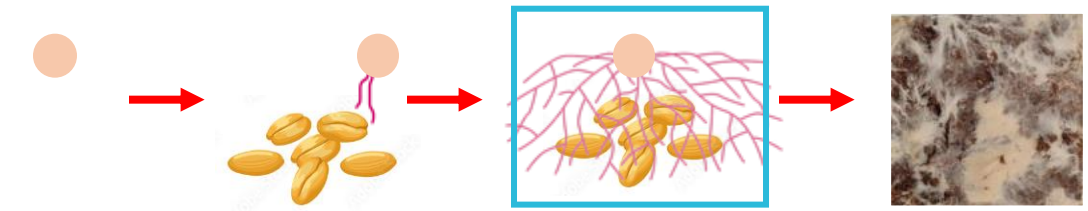
Production Cycle of a Mycelium Composite



- **Moulding** into desired shape
- **Incubation**: provide sufficient nutrients and suitable temperature, humidity, nutrients, pH, etc.
- **Demoulding**
- **Drying**: 90-120°C; 12-48 hours

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Why MCs?

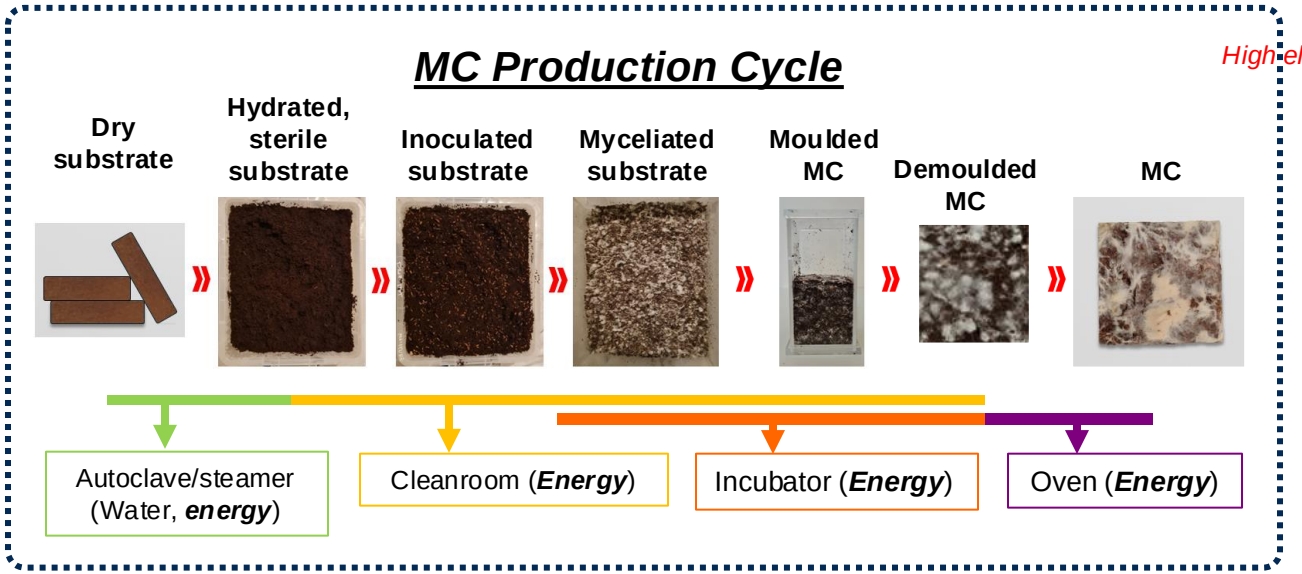
1. ***Composition***: biobased, comprising organic particles and mycelium matrix
2. ***Raw materials***: nutrients obtained from waste organic matter (from agriculture, agro-industry, forestry sectors); added value
3. ***Manufacturing***: minimal energy
4. ***End-of-life***: can be recycled or composted

Thus, MCs broadly meet criteria for sustainable construction materials

The Hy-fi Tower, MoMA Exhibition
https://www.holcimfoundation.org/projects/hy-fi

Fig. 1(continued) *Some MC applications*

Are MCs eco-friendly?



Footprint is mostly influenced by electricity and longevity

a. Electricity: consumption and source (fossil fuel vs renewable energy)

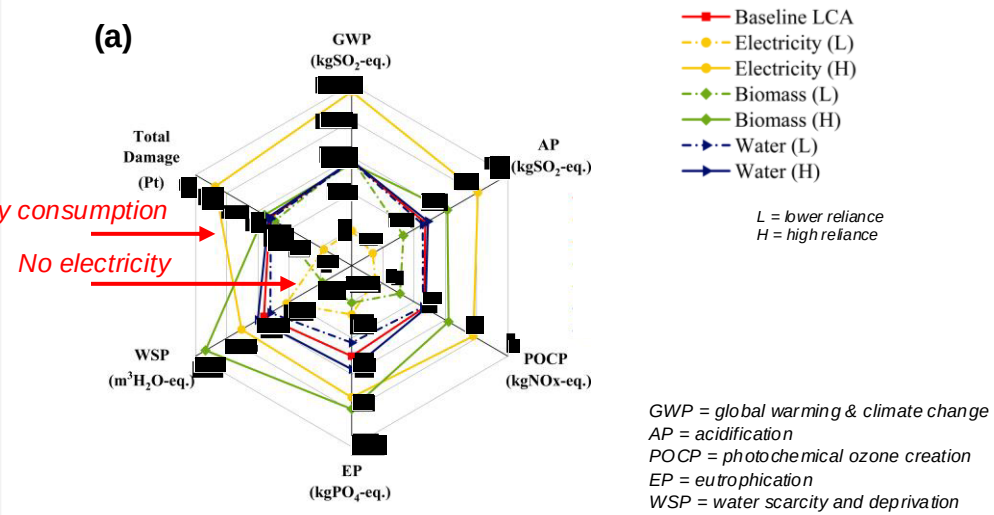


Fig. 2 *(a) Sensitivity to process parameters and (b) comparison with concrete bricks*

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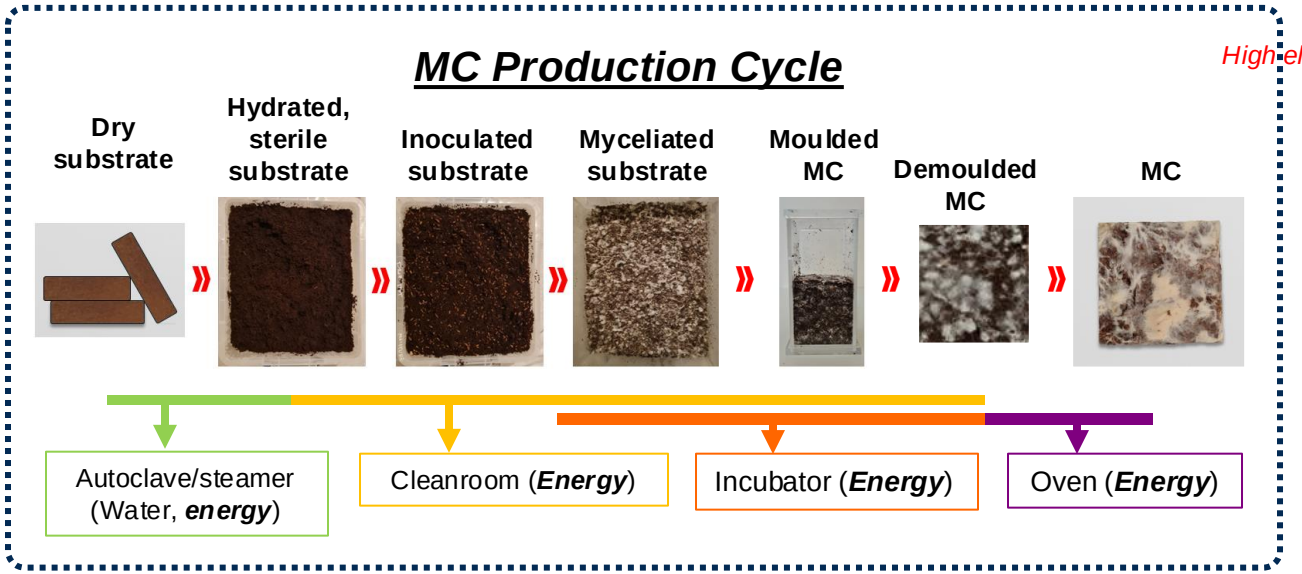


Footprint is mostly influenced by electricity and longevity

a. Electricity: consumption and source (fossil fuel vs renewable energy)

b. Longevity; MCs last ~20 years, with regular maintenance and replacement; concrete bricks can last >100 years without major maintenance

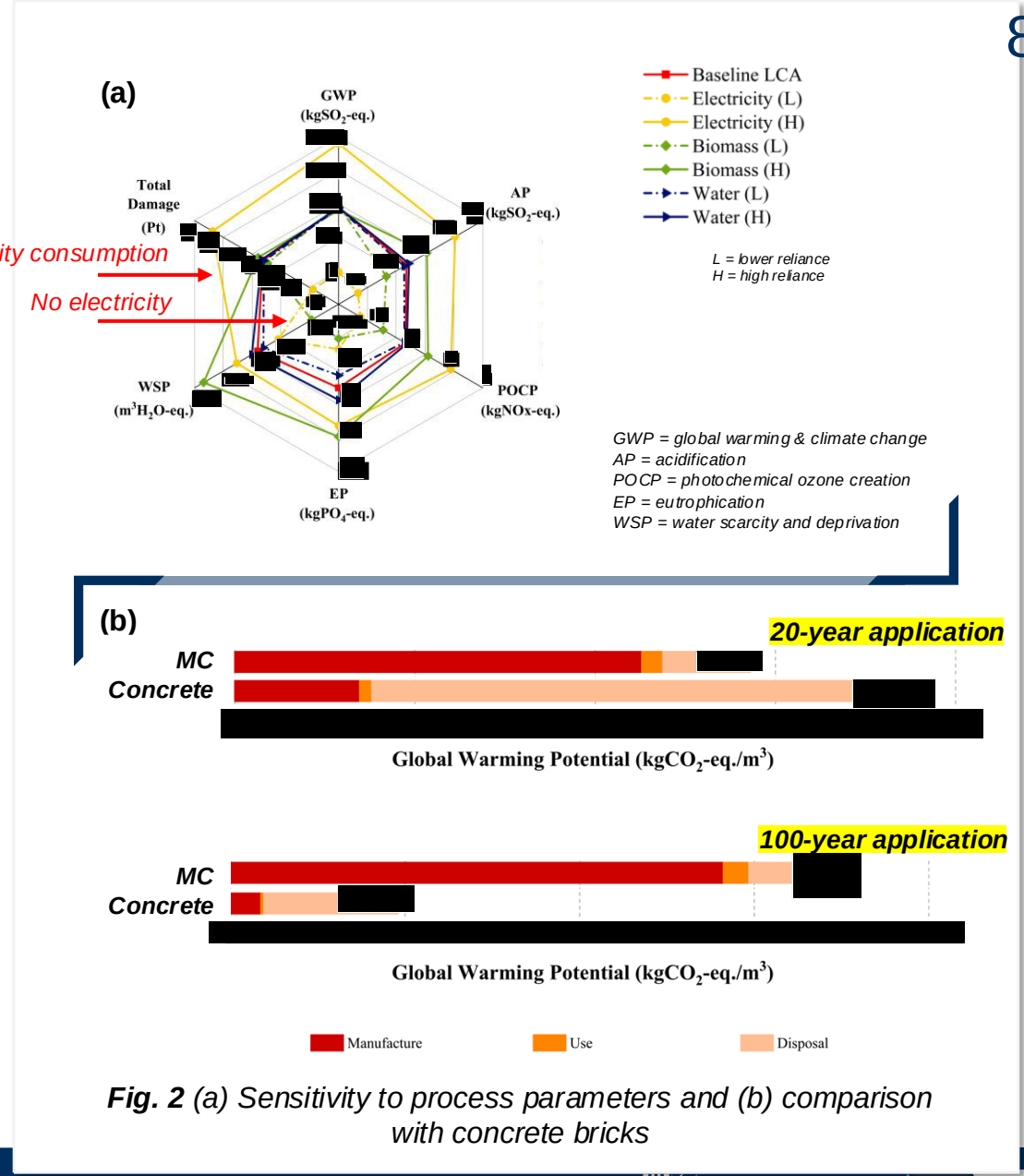


Fig. 2 *(a) Sensitivity to process parameters and (b) comparison with concrete bricks*

Are MCs practical?

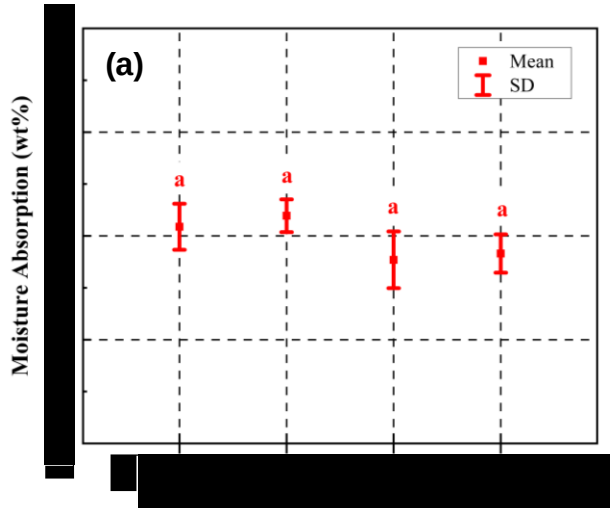
MCs are sensitive to humidity (& other environmental factors) due to:

- ***Composition***: lignocellulose reinforcement is highly hydrophilic
- ***Microstructure***: mycelium (hydrophobic) absorbs and retains water by capillary action

Conditioning
T = 40ºC;
RH = 85%;
time = 7, 14, 21, 28 days

Compressive test
Crosshead displ. = 1 mm.min^{-1}

Fig. 4 *Experimental procedure.*



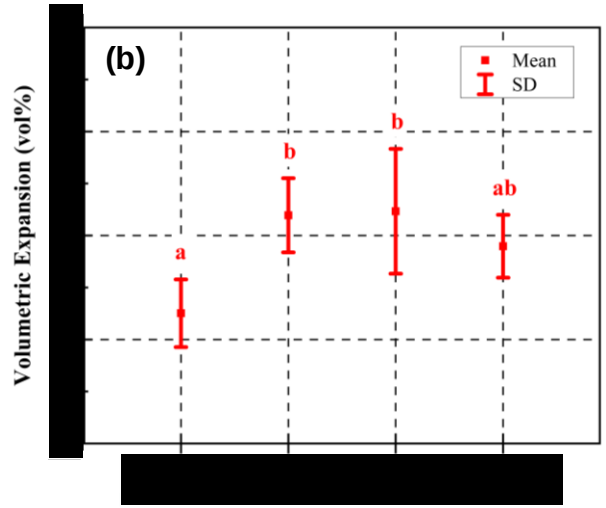


Fig. 5 *Progressive (a) moisture absorption and (b) volumetric expansion in 28 days. (a) Stress-strain curves and (b) compressive strength of MCs.*

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Strength reduction mainly due to loss of stiffness in the mycelium matrix (plasticisation effect)

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Compressive test
Crosshead displ. = 1 mm.min^{-1}

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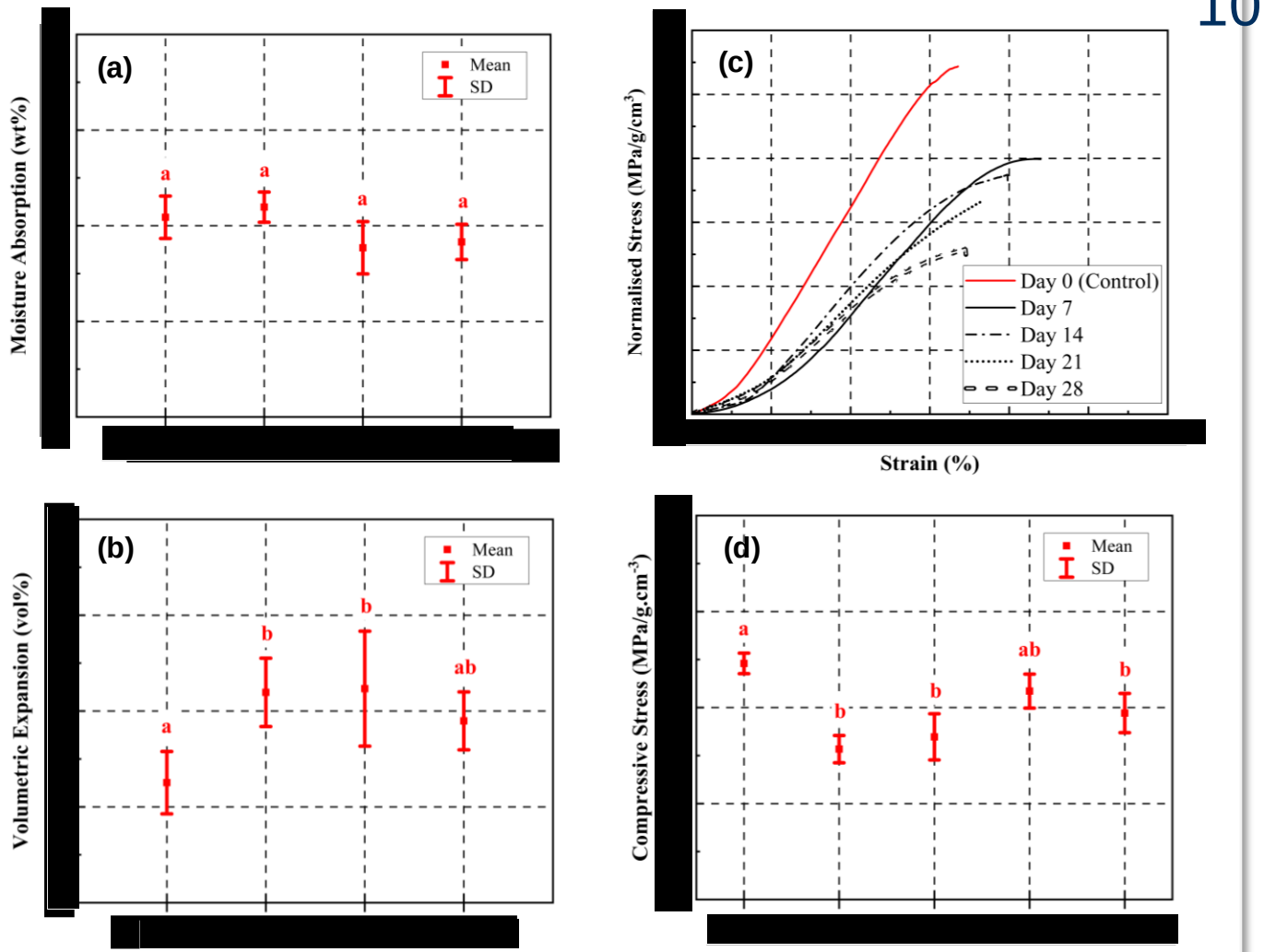

Fig. 5 *Progressive (a) moisture absorption and (b) volumetric expansion in 28 days. (c) Stress-strain curves and (d) compressive strength of MCs.*

In conclusion:

Are mycelium composites sustainable in construction?

Come to my poster and let's have a conversation!

Interested in my work?

- Akromah, S., Chandarana, N. & Eichhorn, S. J. **Mycelium composites for sustainable development in developing countries: The case for Africa**. *Adv. Sustain. Syst.* (2023)
- Akromah, S., Chandarana, N. & Eichhorn, S. J. **Potential environmental impact of mycelium composites on African communities**. Sci. Rep. (2024)

In conclusion:

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Future work

Microstructural modification to address the strength and hygroscopic limitations, by taking advantage of the inherent microporosity of the mycelium matrix

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Acknowledgements

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University of BRISTOL

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Questions?

s.akromah@bristol.ac.uk

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