

The Science of Biodegradable Composites

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*The planet is in grave danger. Global warming threatens to destroy everything. But there is hope...
Mycelium Man, with extraordinary powers, can save the world!*



Figure 1: Mycelium Man, the hero who just might save animals, humans, and entire ecosystems from extinction.

The superpowers:

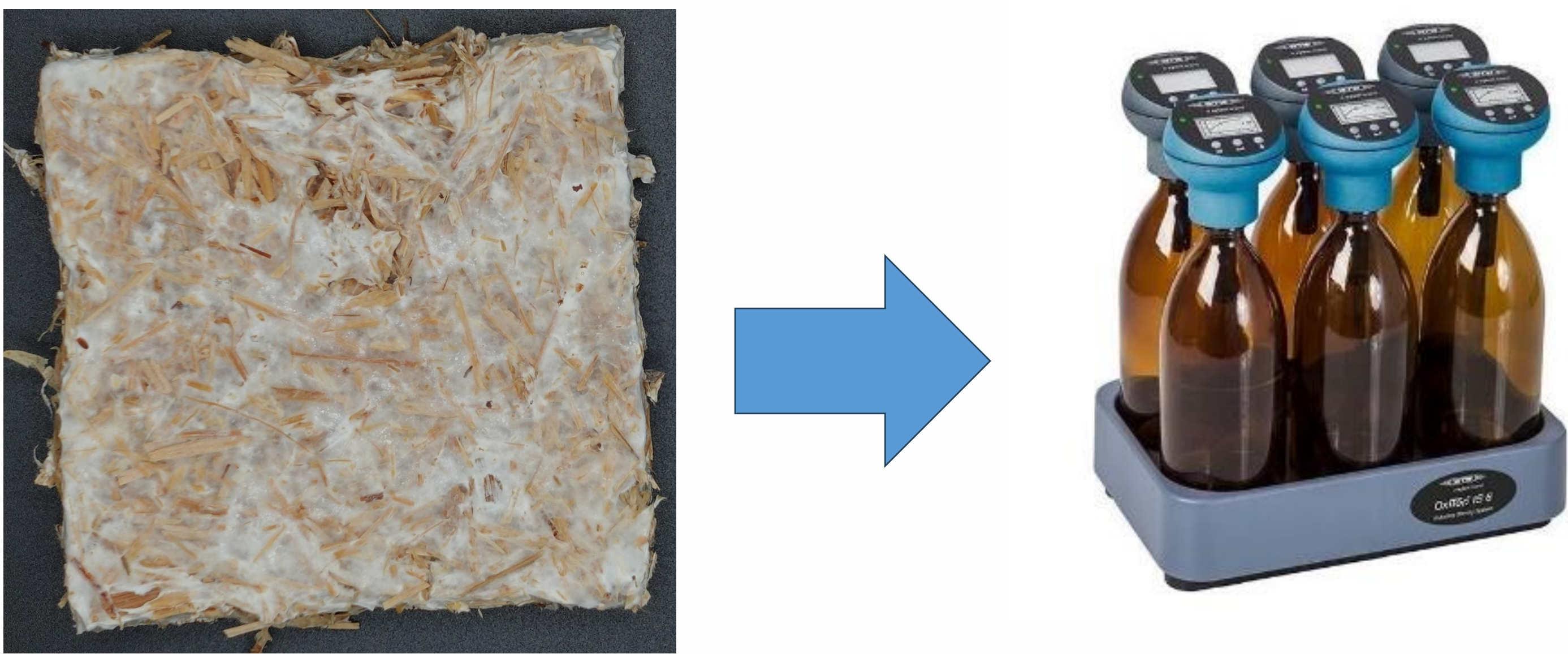
- Heat and sound absorbent.
- Low ecological (CO₂) footprint.
- Self-healing.
- Ability to take different forms.
- Fire resistant.
- Sustainable.

Introduction

Renewable and biodegradable, MBMs are grown from fungi on organic waste (Girometta et al., 2019). This study examines their biodegradability, focusing on pH and post-processing methods. According to ISO 14851, a material is considered biodegradable if it achieves at least 60% decomposition in 28 days under controlled aerobic conditions (NEN-EN-ISO 14851, 2019).

Methodology

This study assessed the biodegradability of mycelium bio-composite materials (MBMs) using OxiTop Biochemical Oxygen Demand (BOD) testing. Samples were pre-treated with acid, alkaline, or demineralized water and compared to expanded polystyrene (EPS). The tests simulated natural biodegradation conditions using activated sludge inoculum, measuring oxygen consumption over 28 days.



Mycelium

OxiTop

Figure 2: Mycelium Bio-Composite sample is measured with the OxiTop system (OxiTop®-i IS 6 - ECOSPHERE, 2019).

Results & Discussion

The following table summarizes the biodegradation percentages after 28 days for each sample type, highlighting whether the ISO threshold of 60% was met.

Sample Type	Time (days)	Biodegradation (%)	Met ISO 14851 Standard?
MBM Insulation	20	32,3	No
MBM Insulation with Coating	28	40,6	No
MBM Boards	28	38,4	No
MBM Boards with Coating	28	42,4	No
Expanded Polystyrene (EPS)	28	6,1	No

Figure 3: Table with the degradation rates in percentage. None of the MBM samples met the ISO 14851 biodegradability threshold of 60% decomposition within 28 days.

The two figures below illustrate the biodegradation trends over time

BOD (mg/L) Comparison Between Blanc and Untreated Mycelium Over 20 Days

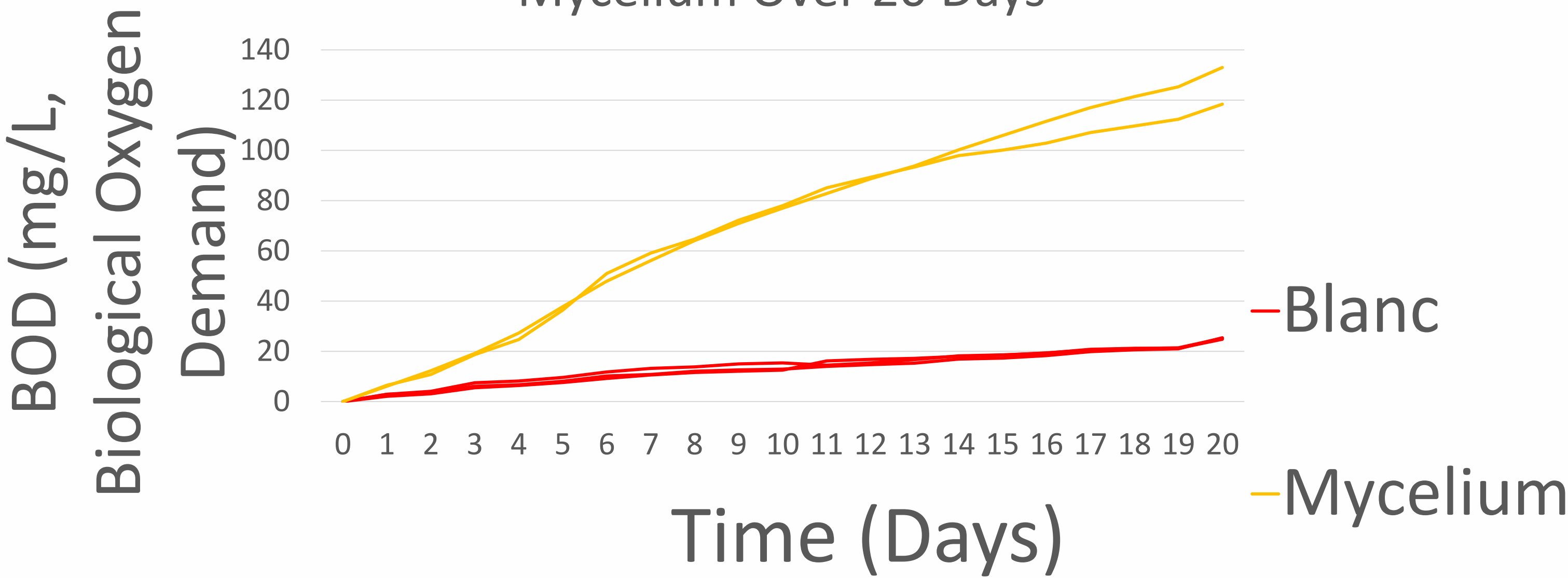


Figure 3: Graph of the BOD comparison between blanc and untreated mycelium samples over 20 days.

Effect of Treatments on Mycelium BOD (mg/L) Over 20 Days

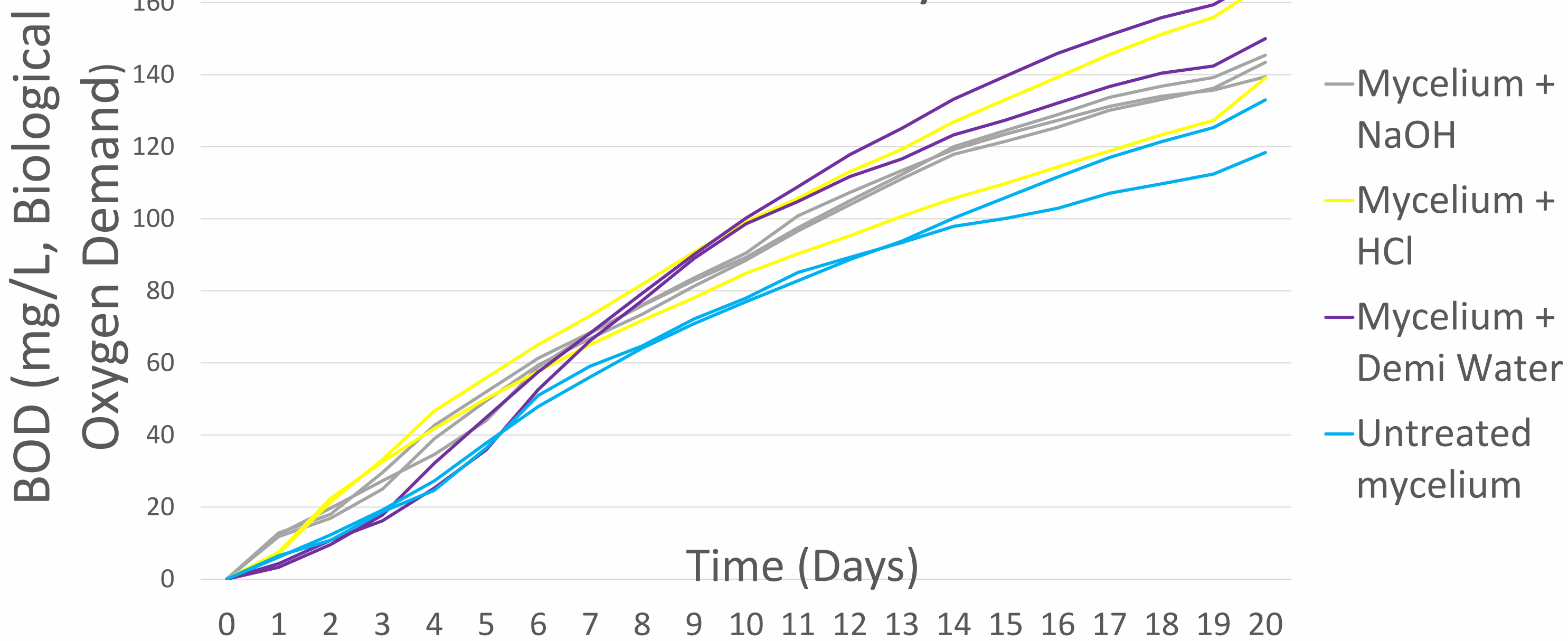


Figure 4: Graph of the BOD comparison between acidic (HCl), neutral (demi-water), and alkaline (NaOH) treated mycelium samples over 20 days.

Conclusion

None of the MBM samples met the ISO standard, with the highest biodegradation rate observed being 42.4% for MBM Boards with Coating.

References

1. Girometta et al., 2019 (<https://doi.org/10.3390/su11010281>).
2. NEN-EN-ISO 14851, 2019.
3. OxiTop®-i IS 6 - ECOSPHERE, 2019 (<http://ecosphere.com.mx/producto/oxitop-i-is-6/>).