CORTEZA

Additive Manufacturing of **Cork Furniture**

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This research aims to address the noise pollution problem and explore the potential of 3D-printed cork as a sustainable solution. The primary objective is to contribute to the global effort to combat noise pollution, recognising its negative effects on human health and well-being. Specifically, the research aims to use innovative materials and fabrication techniques to develop effective and sustainable solutions.

A noise level of more than 65 dB is considered noise pollution. Thirty-two million Europeans are annoyed by unwanted noise. Noise pollution is becoming a global priority, and it is affecting everyone. This project has been driven by current noise pollution problems in metropolitan cities, especially in our homes. Cork is one of the sustainable materials that can be used to tackle the noise pollution problem.

However, the use of cork brings attention to underutilized cork waste, as well as the cork stopper waste that is inevitably produced. In the cork industry, the primary waste product is cork granulate or cork dust, often called “cork powder.” This byproduct results from the manufacturing processes of creating cork-based products such as wine stoppers, flooring, and insulation. Tiny particles and dust are inevitably produced when the cork is cut, shaped, or drilled to meet specific product specifications. However, it is worth noting that the cork industry can use. The recyclability and biodegradability of cork ensure that it leaves a minimal ecological footprint. If they are decomposed or incinerated, they release the CO_2 into the atmosphere, contributing to global warming. Recycling not only prevents the release of CO_2 into the atmosphere but also extends the ability of cork to retain CO_2 to be extended.

In order to reduce the levels of noise pollution and the environmental impact of cork waste, a system for upcycling cork dust and cork granules to create furniture utilizing additive manufacturing has been developed. This system comes with several significant benefits. Most importantly, using 3D printing technology and additive manufacturing enables printing more complex and custom geometries during furniture fabrication.

3D printing cork is mostly explored with chemical binders such as Polylactic acid/Polyethene (PLA.. However, cork without PLA is entirely unexplored in 3D printing. For the furniture to keep its sound absorbing properties, it was essential for this research to have natural binders for cork bio composite that can be recyclable in the future.

Therefore, the experimentation began with exploring natural binders for cork granules to use in 3D printing. We created prototypes using different cork granule sizes and clay to evaluate each material’s flexibility, strength, and noise absorption coefficient. Our comprehensive exploration of biocomposites led us to gain insights into how differently sized cork granules interact with sound waves when combined with various biocomposites and geometries.

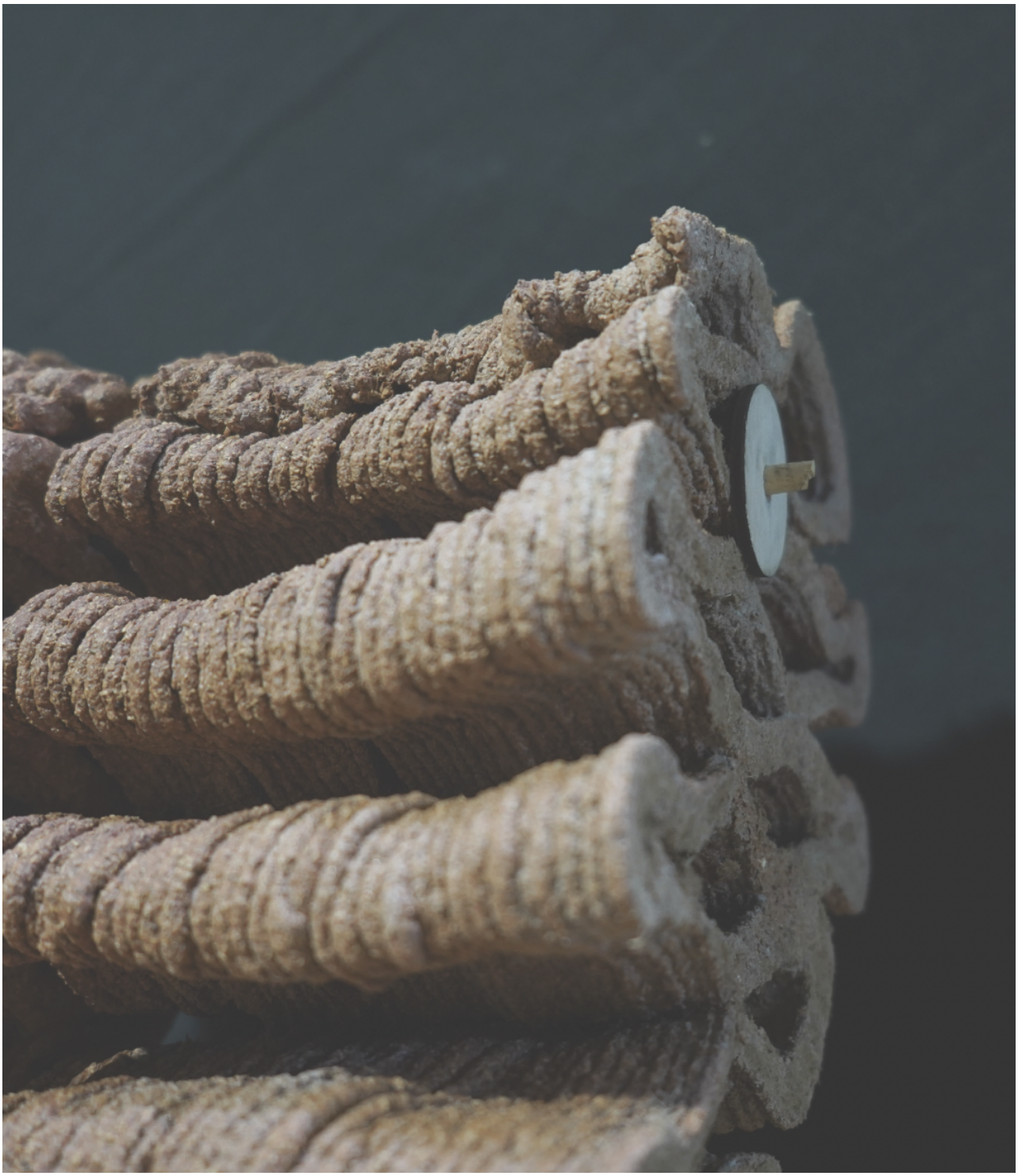
Afterwards, the objective was to explore different levels of porosity and sound-absorbing capabilities within the 3D-printed cork bio-composite furniture. This step aims to optimise the material's acoustic insulation properties by leveraging the cork's ability to absorb sound waves effectively.

The Corteza chair was created by taking into consideration many aspects. By replication of the cork biomimicry, it creates a porous design. However, to increase the strength of the weaker points, the midpoints of the chair, the infill gets denser to avoid fracturing after the drying process. The rotation of the infills on three different parts gives a cushioning effect, increasing the chair's flexibility and comfort. Due to the porosity, the noise scatters and reflects, and the cork composite absorbs the noise. The curvature of this prototype decreased from bottom to middle and then increased again from centre to top to increase the comfort of the chair prototype.

A 6-axis Ur Robot with a single extruder and Lutum cartridge was used during printing. Due to the foreseen possible bucklings, the chair was printed in two different parts. Each module took approximately two weeks to dry thoroughly. Printing the chair in two different modules helped the drying process by reducing the drying time. After a week of drying, even though the inside of the pieces were still wet, the pieces were quite stiff for the attachment. The two pieces were connected through the open pores with six millimetres of wooden sticks, and four rectangular wood pieces were screwed to the MDF board to hold and let the chair dry thoroughly without getting moved or deformed. After a while, the chair dried inside and outside and was able to hold a human weight on it.

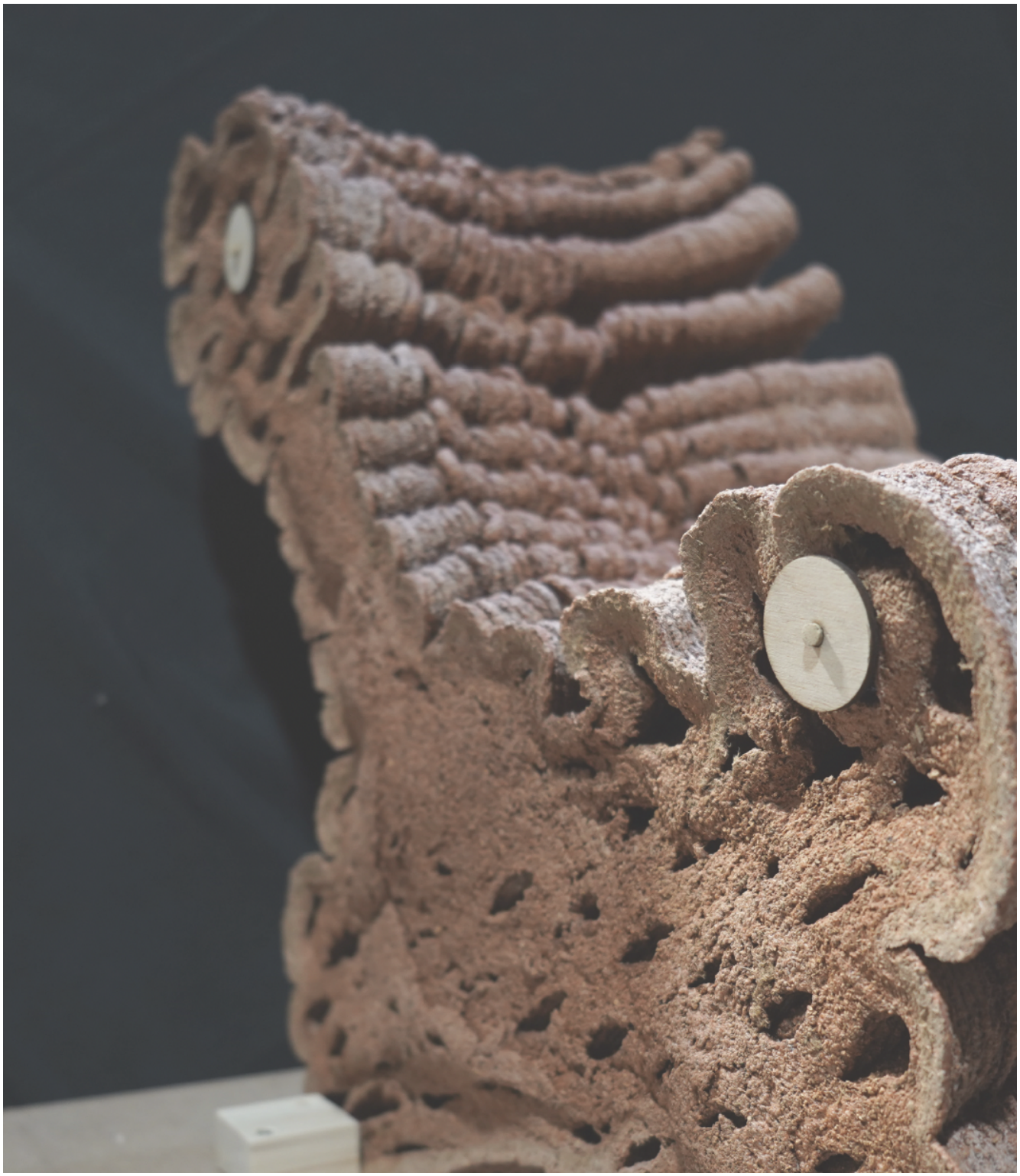
The research outcomes demonstrate the potential of 3D-printed cork bio-composite furniture as an effective and promising means to fight noise pollution within our homes. Our study represents a significant step forward in leveraging 3D-printed cork for noise comfort. It opens new opportunities for future research into diverse applications and designs of cork composites within 3D-printed functional furniture by positively contributing to the ongoing challenge of reducing noise pollution while highlighting the unique attributes of cork as a versatile and eco-friendly solution.

Keywords: Noise Pollution, Cork Bio Composite, 3D Printing, Granules, Cork Stopper Waste



(Pic 1)[1]

[1] Pic 1 - Corteza Chair Application- Photo Credit: Gizem Demirkıran (Author)



(Pic 2)[2]

[2] Pic 2 - Corteza Chair Application- Photo Credit: Gizem Demirkıran (Author)