bio-host glass:

A recycled porous glass foam, optimized for bioreceptive applications in the urban environment.

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5. Reflection

The starting point of this research has been on providing new market applications for glass waste that currently remains unutilized. To do this, bioreceptivity was chosen as an upcoming trend to serve the means to this purpose. Therefore, out of the proposed graduation topics a new one was formed by combining some existing concepts developed to promote sustainability in the construction industry. On the one hand, testing methods to re-introduce material waste and especially upcycle glass is of utmost importance, since currently there is a linear process prevailing from the manufacturing of glass products – apart of bottles – until the end-of-life usage of a product, that gets landfilled. On the other hand, bioreceptivity as a phenomenon benefits greatly the urban environment in a bigger scale by creating a better microclimate against climate change effects, while also takes advantage a natural phenomenon in materials that is now considered to be negative.

The experimental research approach that was followed, had been based at a great extend on literature findings and used them as a starting point for testing. I feel that the process could not have been followed in a different way, since the topic and the set goal was to complex to be fully-achieved in this short-period of time. The research question is answered holistically by the conclusions of this study, not by a final product or material that one may expect, but with a designed methodology based on the findings already achieved by now, and specific aspects for further research and experimentation that could consist many different graduation topics or even one PhD thesis.

Specifically, the variables that had to be considered are immense and only revealed to me, when I had delved into the topic, by combining knowledge found in the literature from different fields of expertise. Due to the topic's novelty, only through the guidance of my mentors, I managed to focus my thinking on defining a strategy for dealing with this specific topic and determine its engineering and design requirements. Thus, its relevance with the Building Technology track is absolute because it combines both the methodological thinking for engineering by analyzing a problem and identifying the specific inputs and outputs that have to be generated to reach to the desired solution, or define the steps towards your goal.

What's more, from the problem statement the main inspiration was to take advantage of certain criteria that lead to bioreceptive performance, such as porosity and non-transparency, that for any other application derived from glass would pose a major flaw, therefore the topic's contribution to the scientific world can be identified in multiple aspects, no matter its size. Firstly, by addressing the development of a new material, new experiments held during the time of this graduation, offer findings for innovation, in the same way that I was investigating evidence by unsuccessful experiments that would serve the purpose of porosity and crystallization in recycling glass, in order to achieve open-porous glass foams, which are exactly the opposite than the current industry offers. Secondly, extensive information was collected from published lab-experiments that other researchers have already conducted, in order to define, not only the testing process for such a phenomenon, but also the desired values for material properties that would serve as exemplary results to be achieved in my work.

A proof of the aforementioned is the fact that, this work already offers a guideline for young researchers participating in Bucky Lab studio having bioreceptivity as the main topic. Although the desired range for the material properties, optimized for bio-colonization, could not been accurately defined, the collected information enabled me to deeply understand porosity as a material process and search for ways to achieve the right pore network for optimum water behavior. It is an undeniable fact that, until now there has not been any research in the field about manufacturing such properties, but only enhancing the ones that are already described as inherent.

All the above, offer insight also to the societal relevance, to which greatly contributes even the formed topic itself highlighting extremely contemporary problems of the construction industry and suggests a competitive solution, once it is achieved.

However, to accomplish the execution of an idea that has not been done or researched before entails great difficulties and challenges. For this specific topic investigating material properties, climatic conditions and natural phenomena related to our urban environment, such problems may would have been easier to tackled if more experts, - apart from the mentors - could offer their insight on the topic. Despite the fact that not only did I try to take advantage of talking with other researchers, but also promoting to them my work and the difficulties that I encounter, this contact was not enough at the first steps of the research, mainly due another outbreak of corona. A potential result of this, would be the need of extensive experimentations and testing, in order to achieve the goal of my graduation topic and conclude to a final material. However, this act would entail an ethical dilemma regarding the consumption of huge amounts of material for mould casting and energy for heating the samples. Towards this, working closely with Telesilla Bristogianni my mentor both in the topic and in the lab, the samples produced were minimized and their results examined carefully, for the purpose of assessing with scrutiny the next experiments, so as to avoid superfluous work for the scope of this research.

Overall, what I learned is that regardless of the experimental results, it is of utmost importance to report every step with scrutiny and provide all the knowledge you have gained that can be taken advantage for further research and exploration. For this reason, I chose to also work on building a catalogue of potential applications for bio-host glass before it is even created or tested, by highlighting the engineering steps and requirements towards their manufacture. Due to the limited time frame of this graduation topic, specific variables could be further explored, thus the designed applications will already constitute a solid basis on the general specifications for the new material. This fact illustrates a vast potential for bio-host glass, since this material emerges out of current industrial waste and replaces existing products with enhanced ecological benefits related to climate change mitigation tactics.