

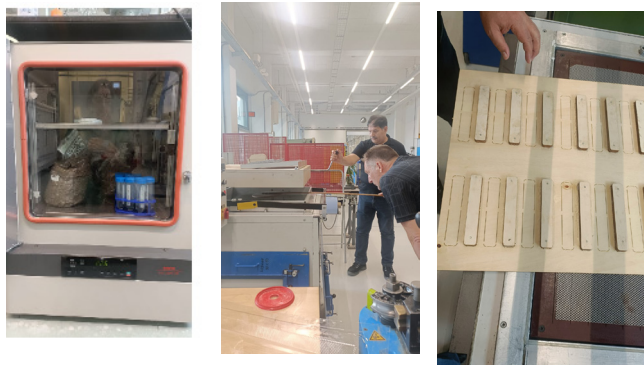
# APPENDIX 1

What went behind the

Development of Mycelium composites



Sample preparation:  
Substrate (Sawdust/hemp) + Wheat  
added in (1:10) ratio  
Water is added till the substrate is damp  
Autoclaved at 120 degree Celsius  
Grow it in the molding bag



Incubation temp- 27 degree Celsius  
Mold formation: Vacuum Forming  
Mold Material: Acrylic polymer sheet

Mycelium inactivation condition: 50de-  
gree Celsius for 24 hrs



# APPENDIX 2



## Safety Sheet

according to NOM-018-STPS-2015

IMPERSHIELD BIOSEAL MYCELIUM

### 1-Product

Product Name:	BIOSEAL MYCELIUM
Chemical Name:	Natural vegetable copolymer
Chemical Family:	Stretched acrylic-like copolymer
Usage:	Impregnation product on mycelium composites
Manufacturer Information:	IMPERSHIELD EUROPE B.V.
Address:	Kleijweg 6, 2635 BR, Den Hoorn ZH, The Netherlands
Email Address:	<a href="mailto:info@impershield.eu">info@impershield.eu</a>
Telephone Number:	+31 (0)6 11 41 24 26

### 2-Hazard Identification

#### Classification SGA

<b>Acute Toxicity</b>	Category 5
Warning	⚠ Attention
Hazard Statements	May be harmful if swallowed
<b>Skin Irritation</b>	Category 3
Warning	⚠ Attention
Hazard Statements	Causes mild skin irritation
<b>Eye Irritation</b>	Category 2B
Warning	⚠ Attention
Hazard Statements	Causes eye irritation

#### Precautions

If swallowed, do not induce vomiting, consult a doctor. Contact for very long periods of time with the skin can cause a slight irritation on delicate skin. Wash thoroughly with plenty of water and mild or neutral soap. Contact with the eyes can irritate and form a film on the membrane of eye. Wash thoroughly with direct stream of water for 15 minutes, a medical check-up is recommended.

### 3-Composition/Information on Ingredients

Percent by Weight	Components No.	Cas No.	Classification
9,5 - 10,5 %	Natural vegetable copolymer similar to styrene acrylic	N/A	Acute toxicity category 5 Skin irritation category 3 Eye irritation category 2B

### 4-First Aid

#### Intake

If swallowed, do not induce vomitin , see a doctor.

#### Eye Contact

In case of contact with eyes wash thoroughly with direct stream of water for 15 minutes, a medical check-up is recommended.

#### Skin Contact

Contact for very long periods of time with the skin can cause a slight irritation on delicate skin, wash thoroughly with plenty of water and mild or neutral soap.

### 5-Steps to Be Taken in Case of an Accidental Spill or Leak

Non-hazardous product. The use of safety glasses, an apron, gloves and rubber boots are recommended as precaution. In the event of a container leak, stop the leak by covering the source, if possible, rotate the container so that the source is facing up. Transfer the material. In case of a storage tank, it is recommended to plug it without risk, and once it is empty, proceed to its repair, if possible, transfer the material. In case of spillage form a dam with absorbent material (sand) or with the spill containment kit, preventing the product from spreading or reaching the drains, collect as much as possible and deposit it in suitable containers for disposal, considering that this product is not dangerous. The residues that remain on the surface must be washed with water, ensuring that the place is clean.

### 7-Handling and Storage

Under normal storage and handling conditions, the product has excellent stability and does not require special precautions. Store indoors to avoid creaming or freezing.

#### 9-Physical and Chemical Properties

Physical State:	Liquid, bluish white color.
Smell:	Characteristic smell
PH:	7.5 – 9.5
Initial Boiling Point and Range:	100° C
Flashpoint:	N/A
Evaporation Rate:	N/A
Upper / Lower flammability or Explosive Limit:	N/A
Vapor Density:	0.62 (water) (air=1)
Relative Density:	1.0 gr./cm3 (@ 22°C approx.)
Solubility (ies):	in water 17 mm Hg (water) at all emulsion ratios
Autoignition Temperature:	N/D
Molecular Weight:	N/D
Percentage of Volatility:	N/A only forms water vapor

#### 10-Physical and Chemical Properties

Chemical Stability:	stable substance
Conditions to Avoid:	N/A
Incompatible Materials:	Acids and alkaline materials (such as caustic soda or potash) (with other materials) Excess charges such as carbonates and oxidizing agents (peroxides) Acrylic thickeners can cause clotting
Hazardous Decomposition Products:	N/A

#### 11-Toxicological Information

Immediate and delayed effects, as well as chronic effects produced by a short or long term exposure:	
Ingestion	Could cause upset stomach
Eye Contact	In case of contact with eyes wash thoroughly with direct stream of water for 15 minutes, a medical check-up is recommended
Skin Contact	If there is direct contact with the skin for very long periods of time with the skin can cause a slight irritation on delicate skin, wash thoroughly with plenty of water and mild or neutral soap.

#### 12-ecotoxicological Information

No product data available.

#### 13-Information Regarding the Disposal of the Products

This product is defined as a non-hazardous material for the environment. The disposal of this product or its residue must be carried out following the legal provisions established in your locality, also considering the mixture that will be made by substances other than the product.

#### 14-Information Regarding the Disposal of the Products

Classes of Hazards in Transport	N/A
Environmental Risks	N/A
Special Precautions for the User	N/A

For transportation purposes, this product is defined as a non-hazardous material.

#### 15-Regulatory Information

Intended for use by professional users only.

#### 16-Other Information

##### Unloading

The information is believed to be correct, but is not exhaustive, and will be used only as an indication, which is based on current knowledge of the chemical or mixture and is applicable to the appropriate safety precautions for the product.

##### Statement

Impershield Europe B.V. publishes the information contained herein in good faith, however, makes no representation as to

Kleijweg 6, 2635 BR, Den Hoorn ZH, The Netherlands

IMPERSHIELD EUROPE B.V.

For more information contact an Impershield advisor or go to [impershield.eu](http://impershield.eu)

# APPENDIX 3

Force and weight calculations for bio based panels

Length (mm)	Breadth (mm)	Thickness (mm)	Volume (mm)	Mass_ABS+PC (kg)	Fmax_ABS+PC (N)	Mass_Balsa (kg)	Fmax_Balsa (N)	Mass_TPW (kg)	Fmax_TPW (N)	Mass_FP (KG)	Fmax_FP (N)
400	80	1	32000	0.0368	8	0.0096	3.573333333	0.04672	18.93066667	0.037696	9.066666667
400	80	2	64000	0.0736	32	0.0192	14.293333333	0.09344	75.72266667	0.075392	36.26666667
400	80	3	96000	0.1104	72	0.0288	32.16	0.14016	170.376	0.113088	81.6
400	80	4	128000	0.1472	128	0.0384	57.173333333	0.18688	302.8906667	0.150784	145.0666667
400	80	5	160000	0.184	200	0.048	89.333333333	0.2336	473.2666667	0.18848	226.6666667
400	80	6	192000	0.2208	288	0.0576	128.64	0.28032	681.504	0.226176	326.4
400	80	7	224000	0.2576	392	0.0672	175.0933333	0.32704	927.6026667	0.263872	444.2666667
400	80	8	256000	0.2944	512	0.0768	228.6933333	0.37376	1211.562667	0.301568	580.2666667
400	80	9	288000	0.3312	648	0.0864	289.44	0.42048	1533.384	0.339264	734.4
400	80	10	320000	0.368	800	0.096	357.3333333	0.4672	1893.066667	0.37696	906.6666667
400	80	11	352000	0.4048	968	0.1056	432.3733333	0.51392	2290.610667	0.414656	1097.066667
400	80	12	384000	0.4416	1152	0.1152	514.56	0.56064	2726.016	0.452352	1305.6
400	80	13	416000	0.4784	1352	0.1248	603.8933333	0.60736	3199.282667	0.490048	1532.266667
400	80	14	448000	0.5152	1568	0.1344	700.3733333	0.65408	3710.410667	0.527744	1777.066667
400	80	15	480000	0.552	1800	0.144	804	0.7008	4259.4	0.56544	2040
400	80	16	512000	0.5888	2048	0.1536	914.7733333	0.74752	4846.250667	0.603136	2321.066667
400	80	17	544000	0.6256	2312	0.1632	1032.693333	0.79424	5470.962667	0.640832	2620.266667

Force and weight calculations for bio based composites

Length (mm)	Breadth (mm)	Thickness_faceshee t (mm)	Thickness_core (mm)	Mass (kg)	Total Thickness (mm)	Vf	Vc	Flexural strength Faceshee	Flexural strength core	Flexural eq	Fmax
400	80	5.5	11	0.136576	22	0.5	0.5	27	2.86	14.93	963.4827
400	80	5	15	0.13824	25	0.4	0.6	27	2.86	12.516	1043
400	80	2	8	0.209408	12	0.3333333	0.666667	146	2.86	50.57333	971.008
400	80	2	9	0.212224	13	0.307692	0.692308	146	2.86	46.90308	1056.883
400	80	2.5	15	0.23072	20	0.25	0.75	68	2.86	19.145	1021.067
400	80	3.5	10.5	0.29344	17.5	0.4	0.6	68	2.86	28.916	1180.737
400	80			0.4048	11						968
400	80			0.4416	12						1152

Force and weight calculations for composite made of flax panel and mycelium as core

Length (mm)	Breadth (mm)	Thickness_faces	Thickness_core	Mass (kg)	Total Thick	Vf	Vc	Flexural sti	Flexural sti	Flexural ec	Fmax
400	80	1	2	0.081024	4	0.5	0.5	68	2.86	35.43	75.584
400	80	1	3	0.08384	5	0.4	0.6	68	2.86	28.916	96.38666667
400	80	1	6	0.092288	8	0.25	0.75	68	2.86	19.145	163.3706667
400	80	2	4	0.162048	8	0.5	0.5	68	2.86	35.43	302.336
400	80	2	6	0.16768	10	0.4	0.6	68	2.86	28.916	385.5466667
400	80	2	12	0.184576	16	0.25	0.75	68	2.86	19.145	653.4826667
400	80	2.5	5	0.20256	10	0.5	0.5	68	2.86	35.43	472.4
400	80	2.5	7.5	0.2096	12.5	0.4	0.6	68	2.86	28.916	602.4166667
400	80	3	1	0.228992	7	0.857143	0.142857	68	2.86	58.69429	383.4693333
400	80	2.5	15	0.23072	20	0.25	0.75	68	2.86	19.145	1021.066667
400	80	3	6	0.243072	12	0.5	0.5	68	2.86	35.43	680.256
400	80	3	9	0.25152	15	0.4	0.6	68	2.86	28.916	867.48
400	80	3	18	0.276864	24	0.25	0.75	68	2.86	19.145	1470.336
400	80	3.5	7	0.283584	14	0.5	0.5	68	2.86	35.43	925.904
400	80	3.5	10.5	0.29344	17.5	0.4	0.6	68	2.86	28.916	1180.736667
400	80	3.5	21	0.323008	28	0.25	0.75	68	2.86	19.145	2001.290667
400	80	4	8	0.324096	16	0.5	0.5	68	2.86	35.43	1209.344
400	80	4	12	0.33536	20	0.4	0.6	68	2.86	28.916	1542.186667
400	80	4.5	9	0.364608	18	0.5	0.5	68	2.86	35.43	1530.576
400	80	4	24	0.369152	32	0.25	0.75	68	2.86	19.145	2613.930667
400	80	4.5	13.5	0.37728	22.5	0.4	0.6	68	2.86	28.916	1951.83
400	80	5	10	0.40512	20	0.5	0.5	68	2.86	35.43	1889.6
400	80	5	15	0.4192	25	0.4	0.6	68	2.86	28.916	2409.666667
400	80	5.5	11	0.445632	22	0.5	0.5	68	2.86	35.43	2286.416
400	80	6	2	0.457984	14	0.857143	0.142857	68	2.86	58.69429	1533.877333

Force and weight calculations for composite made of Balsa wood and mycelium as core

Length (m)	Breadth (n)	Thickness	Thickness	Mass (kg)	Total Thick	Vf	Vc	Flexural st	Flexural st	Flexural ec	Fmax
400	80	2	6	0.055296	10	0.4	0.6	27	2.86	12.516	166.88
400	80	3	1	0.060416	7	0.857143	0.142857	27	2.86	23.55143	153.8693
400	80	2.5	5	0.06208	10	0.5	0.5	27	2.86	14.93	199.0667
400	80	3	6	0.074496	12	0.5	0.5	27	2.86	14.93	286.656
400	80	3	9	0.082944	15	0.4	0.6	27	2.86	12.516	375.48
400	80	3.5	7	0.086912	14	0.5	0.5	27	2.86	14.93	390.1707
400	80	2.5	15	0.09024	20	0.25	0.75	27	2.86	8.895	474.4
400	80	3.5	10.5	0.096768	17.5	0.4	0.6	27	2.86	12.516	511.07
400	80	4	8	0.099328	16	0.5	0.5	27	2.86	14.93	509.6107
400	80	3	18	0.108288	24	0.25	0.75	27	2.86	8.895	683.136
400	80	4	12	0.110592	20	0.4	0.6	27	2.86	12.516	667.52
400	80	4.5	9	0.111744	18	0.5	0.5	27	2.86	14.93	644.976
400	80	6	2	0.120832	14	0.857143	0.142857	27	2.86	23.55143	615.4773
400	80	5	10	0.12416	20	0.5	0.5	27	2.86	14.93	796.2667
400	80	4.5	13.5	0.124416	22.5	0.4	0.6	27	2.86	12.516	844.83
400	80	3.5	21	0.126336	28	0.25	0.75	27	2.86	8.895	929.824
400	80	5.5	11	0.136576	22	0.5	0.5	27	2.86	14.93	963.4827
400	80	5	15	0.13824	25	0.4	0.6	27	2.86	12.516	1043
400	80	4	24	0.144384	32	0.25	0.75	27	2.86	8.895	1214.464
400	80	6	12	0.148992	24	0.5	0.5	27	2.86	14.93	1146.624
400	80	7.5	2.5	0.15104	17.5	0.857143	0.142857	27	2.86	23.55143	961.6833
400	80	5.5	16.5	0.152064	27.5	0.4	0.6	27	2.86	12.516	1262.03
400	80	6.5	13	0.161408	26	0.5	0.5	27	2.86	14.93	1345.691
400	80	7	14	0.173824	28	0.5	0.5	27	2.86	14.93	1560.683
400	80	9	3	0.181248	21	0.857143	0.142857	27	2.86	23.55143	1384.824
400	80	7.5	15	0.18624	30	0.5	0.5	27	2.86	14.93	1791.6
400	80	10.5	3.5	0.211456	24.5	0.857143	0.142857	27	2.86	23.55143	1884.899
400	80	12	4	0.241664	28	0.857143	0.142857	27	2.86	23.55143	2461.909

Force and weight calculations for composite made of pre treated wood and mycelium as core

Length (mm)	Breadth (mm)	Thickness_facesheet (mm)	Thickness_core (mm)	Mass (kg)	Total Thickness (mm)	Vf	Vc	Flexural strength	Flexural stiffness	Flexural eq	Fmax
400	80	1	2	0.099072	4	0.5	0.5	146	2.86	74.43	158.784
400	80	1	3	0.101888	5	0.4	0.6	146	2.86	60.116	200.3866667
400	80	1	6	0.110336	8	0.25	0.75	146	2.86	38.645	329.7706667
400	80	2	6	0.203776	10	0.4	0.6	146	2.86	60.116	801.5466667
400	80	2	8	0.209408	12	0.3333	0.6667	146	2.86	50.57333333	971.008
400	80	2	12	0.220672	16	0.25	0.75	146	2.86	38.645	1319.082667
400	80	2.5	7.5	0.25472	12.5	0.4	0.6	146	2.86	60.116	1252.416667
400	80	2.5	15	0.27584	20	0.25	0.75	146	2.86	38.645	2061.066667
400	80	3	1	0.283136	7	0.8571	0.1429	146	2.86	125.5514286	820.2693333
400	80	3	6	0.297216	12	0.5	0.5	146	2.86	74.43	1429.056
400	80	3	9	0.305664	15	0.4	0.6	146	2.86	60.116	1803.48
400	80	3	18	0.331008	24	0.25	0.75	146	2.86	38.645	2967.936
400	80	3.5	7	0.346752	14	0.5	0.5	146	2.86	74.43	1945.104
400	80	3.5	10.5	0.356608	17.5	0.4	0.6	146	2.86	60.116	2454.736667
400	80	3.5	21	0.386176	28	0.25	0.75	146	2.86	38.645	4039.690667
400	80	4	8	0.396288	16	0.5	0.5	146	2.86	74.43	2540.544
400	80	4	12	0.407552	20	0.4	0.6	146	2.86	60.116	3206.186667
400	80	2.5	65	0.41664	70	0.0714	0.9286	146	2.86	13.08428571	8548.4
400	80	4	24	0.441344	32	0.25	0.75	146	2.86	38.645	5276.330667
400	80	4.5	9	0.445824	18	0.5	0.5	146	2.86	74.43	3215.376
400	80	4.5	13.5	0.458496	22.5	0.4	0.6	146	2.86	60.116	4057.83
400	80	5	10	0.49536	20	0.5	0.5	146	2.86	74.43	3969.6

# APPENDIX 4

Companies Assignment Brief

## #3 Aerospace Meets Biotech

**Aerospace meets biotech: Designing bio-sourced materials towards functionality for aerospace (mycelium, enzymes, etc.)**

### Problem statement:

Bio-sourced raw materials are emerging materials that are made from renewable resources e.g. agricultural wastes, sugars or fungi feedstock. Their versatile properties make bio-sourced products promising for a wide range of applications. Biotechnology has been applied as a valuable tool to produce useful bio-sourced products. Bio-sourced materials and biotechnology have shown a huge potential to replace conventional petroleum-based materials towards a more sustainable and circular economy. Furthermore, biomaterials are manufactured using low-energy processes from agricultural by-products or wastes. Currently the main applications are packaging, automotive and building materials. First studies showed that bio-sourced materials are also promising alternatives for aerospace applications, e.g. in aircraft secondary structures and interiors. However their application is still limited and some key challenges have to be solved to implement biotechnology and bio-sourced materials in the aerospace industry.

### Research question(s):

**Today, although there are some promising opportunities, bio-sourced products are produced at a small scale. What are the challenges to mature and upscale the technology and make these products the materials of choice for our tomorrow's aerospace applications?**

### Design of new class of materials:

How to answer the demanding aerospace requirements, e.g. high mechanical performance or flame, smoke and toxicity properties, while improving the environmental impacts of the products.

### Market Analysis:

- What are the aerospace needs? e.g. how many biomaterials/biotechnology factories do we need for our aircraft.
- How to set-up this new biomaterial supply chain? Challenges and Opportunities, e.g. viable biobased feedstocks and waste streams identification and if other industries are also interested.
- Are there any economies of scale benefits?
- How to scale-up biological manufacturing processes?

### Life Cycle Assessment:

- How to up-scale the data from the lab scale?
- How to compare the environmental impact of low maturity materials and technologies, and drive the future developments?

### Expected type of work

Interviews, material flow analysis, stakeholder analysis, life cycle assessment

### Available data/reports or other relevant information sources for the assignment

- E. Ramon et al., Aerospace 2018, 5(4), 110; <https://doi.org/10.3390/aerospace5040110>
- S. Bitting et al., Biomimetics 2022 7(2), 44. <https://doi.org/10.3390/biomimetics7020044>
- M. Chaudhry, Master thesis, Delft University of Technology "Designing Circular Applications of Mycelium-Based Materials for Aircraft Cabins" 2023

### Commissioner details

- Department: Airbus Central Research & Development, Materials Domain

Graduation Project Brief



TU Delft

## Personal Project Brief – IDE Master Graduation Project

Name student Chinmayi Narasimha

Student number 5,762,499

### PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title Designing Bio sourced materials towards functionality for aerospace (Mycelium, enzymes, etc)

*Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.*

### Introduction

*Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)*

The aviation industry is experiencing rapid growth, with a projected demand for approximately 42,600 new commercial jets over the next 20 years. In the absence of rethinking technologies, design, and manufacturing of aircraft cabins, cabin waste volumes are expected to double in the next decade. The International Air Transport Association (IATA) aims to promote solutions that reduce industry costs and support the circular economy. One avenue being explored is the use of greener materials. Bio-based materials are one type of greener material offering environmental benefits. This project seeks to assess the viability of such materials as replacements and determine their actual sustainability benefits. However, challenges remain in maturing and scaling up this technology, as well as positioning these products as preferred materials for tomorrow's aerospace. Key among these challenges is the need to modify the material properties of bio-based materials to meet functional and contextual requirements.

### Stakeholders in this context:

TU Delft remains a highly engaged and influential stakeholder throughout this thesis, as the outcomes can serve as the foundation for upscaling diverse product designs made from mycelium sources. Conversely, Airbus' material research team in Munich is also a highly interested and involved stakeholder in the resulting developments related to sustainable structures. The design office situated at Airbus' headquarters in Toulouse, France, possesses competencies encompassing architecture integration, general design, structural design and computation, integration tests, and systems. Initially, this office is expected to wield significant influence but maintain relatively low involvement in initial stages. Stakeholders with considerable interest yet limited influence encompass competitors and existing manufacturing partners, including mycelium-based companies, honeycomb panel manufacturers, seat manufacturers, and other entities within the aircraft interiors supply chain.

→ space available for images / figures on next page

Name student Chinmayi Narasimha Student number 5,762,499

**PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT**  
 Complete all fields, keep information clear, specific and concise

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The aviation industry is experiencing rapid growth, with a projected demand for approximately 42,600 new commercial jets over the next 20 years. In the absence of rethinking technologies, design, and manufacturing of aircraft cabins, cabin waste volumes are expected to double in the next decade. The International Air Transport Association (IATA) aims to promote solutions that reduce industry costs and support the circular economy. One avenue being explored is the use of greener materials. Bio-based materials are one type of greener material offering environmental benefits. This project seeks to assess the viability of such materials as replacements and determine their actual sustainability benefits. However, challenges remain in maturing and scaling up this technology, as well as positioning these products as preferred materials for tomorrow's aerospace. Key among these challenges is the need to modify the material properties of bio-based materials to meet functional and contextual requirements.

Stakeholders in this context:  
 TU Delft remains a highly engaged and influential stakeholder throughout this thesis, as the outcomes can serve as the foundation for upscaling diverse product designs made from mycelium sources. Conversely, Airbus' material research team in Munich is also a highly interested and involved stakeholder in the resulting developments related to sustainable structures. The design office situated at Airbus' headquarters in Toulouse, France, possesses competencies encompassing architecture integration, general design, structural design and computation, integration tests, and systems. Initially, this office is expected to wield significant influence but maintain relatively low involvement in initial stages. Stakeholders with considerable interest yet limited influence encompass competitors and existing manufacturing partners, including mycelium-based companies, honeycomb panel manufacturers, seat manufacturers, and other entities within the aircraft interiors supply chain.

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introduction (continued): space for images

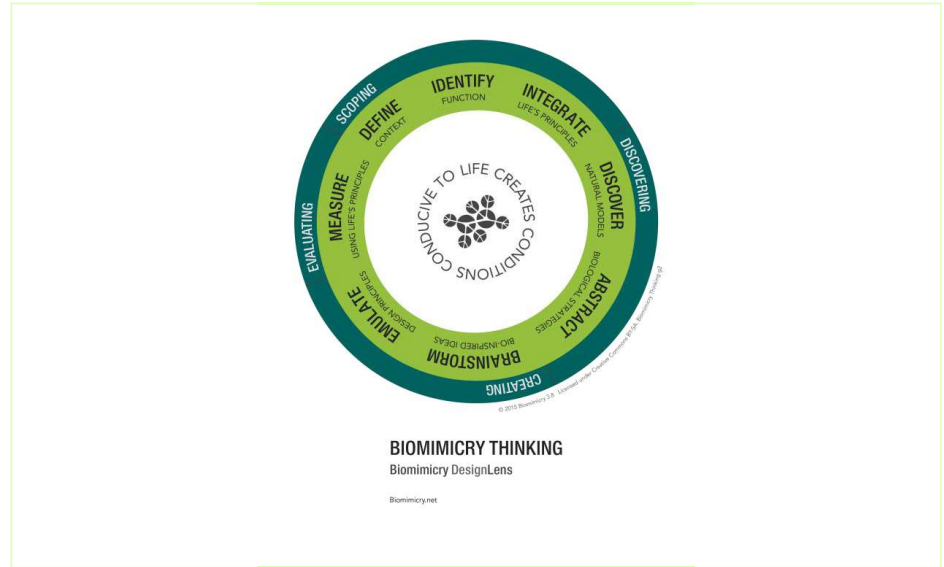


image / figure 1 Biomimicry 3.8. (2023, 6 nov). <https://biomimicry.net/the-buzz/resources/biomimicry-designlens/>

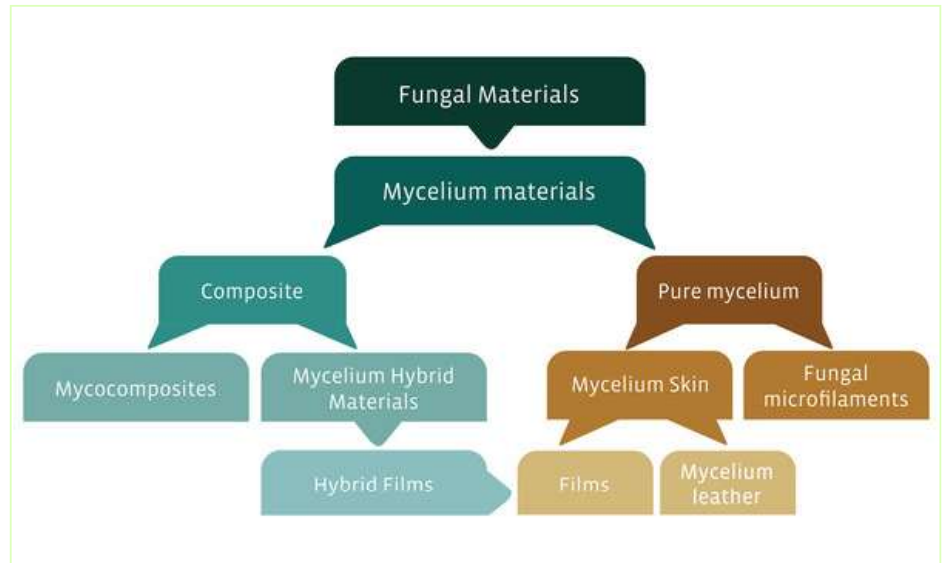


image / figure 2 Current situation and future perspectives for the use of fungi. PeerJ Materials Science, 5, e31



## Personal Project Brief – IDE Master Graduation Project

### Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice. (max 200 words)

Mycelium based composites have already shown potential replacement for aircraft interiors with respect to reduce in weight and waste, thanks to their lightweight and biodegradable nature. Despite these advantages, the aerospace industry has yet to adopt these composites, primarily due to the challenges mentioned below:

1. Despite demonstrating considerable tensile strength, mycelium sheets still require a metal alloy to meet specific requirements. To enhance mechanical strength, no studies have yet optimized the geometric structure of mycelium.
2. A primary concern for aircraft safety is reducing flammability, as evidenced by recent incidents like the Tokyo aircraft crash. Ensuring materials are flame retardant and compliant with FST standards is crucial. This may involve layering with other bio-based materials or redesigning mycelium structures.
3. Currently, there is no validated method or production system to upscale bio-based structural materials for aircraft. Studying and prototyping in feasible ways is essential to demonstrate the potential production methodologies of these materials.
4. Given that mycelium and other bio-sourced materials are fungal-cultivated, understanding how these materials are perceived and their value to companies is crucial. This aspect is planned to be explored through project value modeling.

### Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

*Redesigning an aircraft interior component (panel/armrest/tray table...) using mycelium-bio composites to validate its advantage over existing materials, while simultaneously evaluating their potential to meet industrial standards for scalability.*

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

#### Understanding Context:

- Review of the characteristics of mycelium-based products.
- Evaluate the properties of previously cultivated Mycelium sheet (Flammability, Toxicity, Tensile strength)
- Develop Value curve of Mycelium against existing aircraft Materials (polyethylenimine, Polyurethane, Polyetherimide)
- Ideation to Enhance Material Characterization. (Biomimicry, Co creative workshop, Stakeholder interviews)

#### Material Exploration/Modification:

- Create modifications in material/ Fabricate the designs. (3D printing/molding)
- Develop Material Categorization. (Material ontology to showcase the functionality of each layer/element)

#### Design Development:

- Proposal for Production methods based on the feasible application.
- Product Journey Mapping (Fast track LCA)
- Final Design Development (Detail, accurate prototype and renders)

### Project planning and key moments

To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting, mid-term evaluation meeting, green light meeting and graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).

Make sure to attach the full plan to this project brief. The four key moment dates must be filled in below

Kick off meeting 4 Mar 2024

Mid-term evaluation 15 May 2024

Green light meeting 12 Jul 2024

Graduation ceremony 28 Aug 2024

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	✓
For how many project weeks	9
Number of project days per week	4,0

#### Comments:

Kindly access the sharepoint link for the detailed project planning:  
<https://shorturl.at/pvxJ3>

### Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five. (200 words max)

About me, I studied Chemical Engineering for my Bachelor's degree, specializing in Starch-based bioplastics for my thesis. I switched to product design because I felt limited just working in labs with materials and chemicals without knowing user and market needs. The Sustainable Design Engineering department at TU Delft caught my attention during my undergraduate studies due to its pioneering research and innovative design initiatives and thus I planned my masters in IDE. Since becoming a Master's student, my interest in the program has only grown. I took the initiative to work as a student assistant under the supervision of Ingrid and Jeremy Faludi within this department. Additionally, I am currently moderating edX courses on circular economy. These experiences have afforded me a deeper understanding of sustainable practices.

#### Competencies to demonstrate:

1. Proficiency in material sciences.
2. Expertise in conducting user and stakeholder research.
3. Applying sustainable design methods.

#### Competencies to enhance:

1. Project planning and applying design methodologies on own which will align with the requirements of the project.
2. Consistently upholding responsibility and accountability for the research and design tasks I undertake.
3. Developing stronger communication skills to articulate and present my work more effectively.
3. Strengthen skills in material testing and understand industrial standard requirements

# Project Planning

