High Performance Bio-based Functional Coatings for Wood and Decorative Applications

Greener Raw Materials

The Beauty of Green – Rethinking an Approach to Bio-Based Pigments in Coatings

Stakeholder Workshop in Brussels
2024-04-23

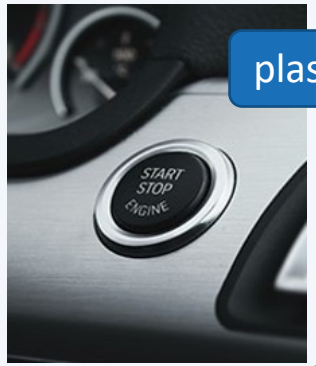
Dr. Amélie Skopp – Technical University of Munich

Horizon 2020
European Union Funding
for Research & Innovation

This project receives funding from the Bio-based Industries Joint Undertaking (JU) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 101022370. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio-based Industries Consortium.

Paint and Coating Basics

Coatings are everywhere!



plastic

glass

mineral substrate

paper

wood

metal

leather

Paint and Coating Basics

Role of Coatings

1. Protection

from weathering
and corrosion

2. Decoration

with colourful, glossy
or matte surfaces

3. Special properties

a) water repellency (house facades)
b) transfer of information (traffic signs, road markings)
c) anti-microbial coatings (hospitals) and many more …

Paint and Coating Basics

Main Ingredients

Binder

Solvents

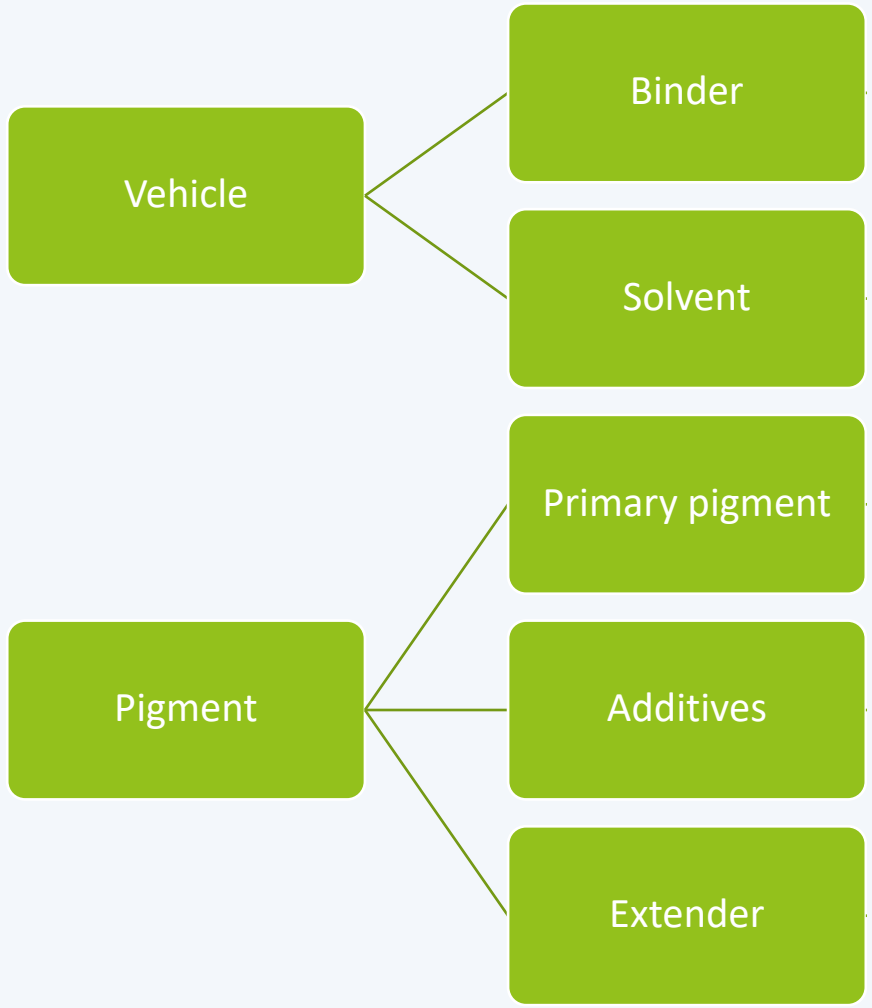
Pigments

Fillers

Additives

Pigment

Paint and Coating Basics



High Performance Bio-based Functional Coatings for Wood and Decorative Applications

WP2

Biomass as Filler Alternative

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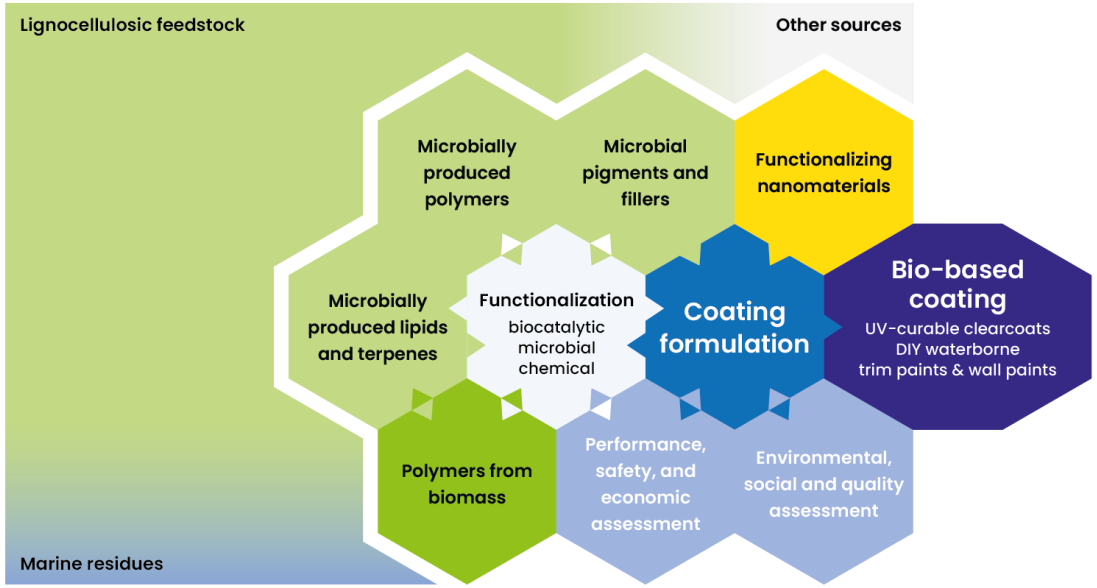
Biomass as Filler Alternative

Non-functionalized fillers

- Candidate filler materials sourced from PerfeCoat sources:
  - Different microbial sources
    - Prokaryotic
    - Eukaryotic

→ No waste within the project



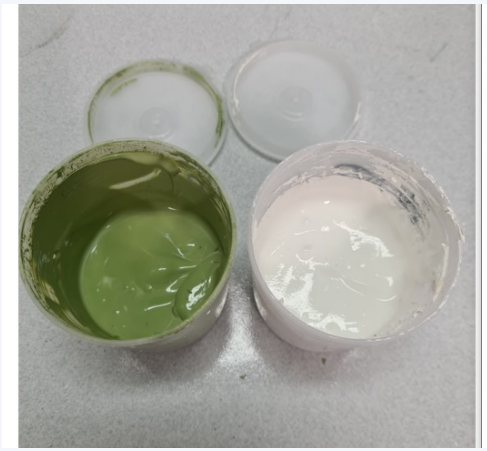
Biomass as Filler Alternative

Non-functionalized fillers

Issues of incorporating microbial cells as fillers:

- Affected rheology
- Affected color
- Molding issues

Top images: Effect of microbial fillers on formulation rheology and color. Left: control PVC80 wallpaint; Middle: microbial filler 1; Right: microbial filler 2
Bottom images: Effect of microbial fillers on storage stability of formulations



Day 1

Biomass as Filler Alternative

Non-functionalized fillers

Performance parameters tested of bio-based filler containing coatings:

- Color
- Gloss
- Rheology
- Scrub resistance
- …

1st generation formulations containing Top left: control standard PVC80 wallpaint

Biomass as Filler Alternative

Non-functionalized fillers

Case study example:

Modifications of bio-based fillers to reduce impact on viscosity and color

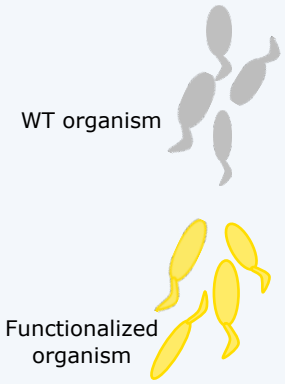
Biomass as Filler Alternative

Functionalized fillers

Can microorganisms be used as functionalizable platform for coatings?

Do microbial functionalizations imbue coatings with the same properties?

Goal: Color-changing bio-hybrid coatings as UV-sensors

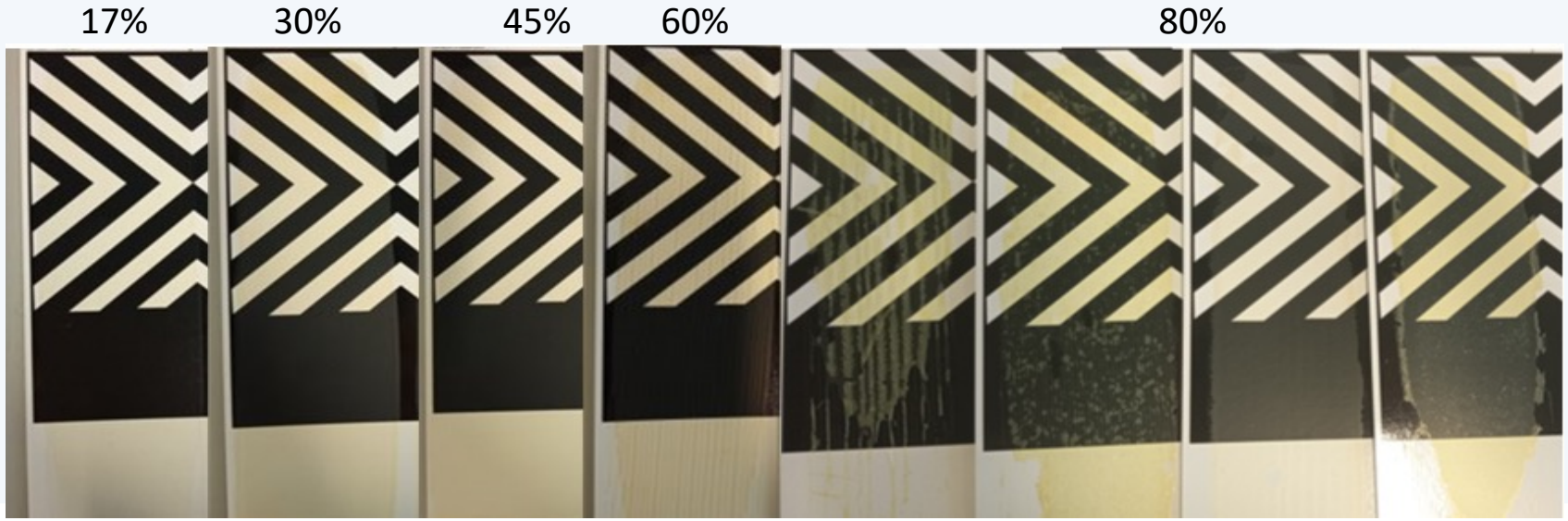


Biomass as Filler Alternative

UV-sensing fillers

Formulation scouting necessary since microbial incorporation changes formulation properties

- Balance between maximum functionalization payoff and film formation needed
- Different PVCs and microbial strains as chassis tested



Formulation scouting of microbial coatings from PVC 17 to PVC80 (indicated by percentage above).

Marosevic M., et al., manuscript in preparation

Biomass as Filler Alternative

UV-sensing fillers

Exposure to UV light changes color of coating irreversibly from green to orange

→ This property was sustained for several months

Marosevic M., et al., manuscript in preparation

Bio-based Industries Consortium
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Biomass as Filler Alternative

Bio-catalytic coatings

Can bio-hybrid coatings be used to address air pollution?

Goal: Removal of VOCs from standard room air by catalytically-active coatings

Skopp, A., et al., 2024, submitted

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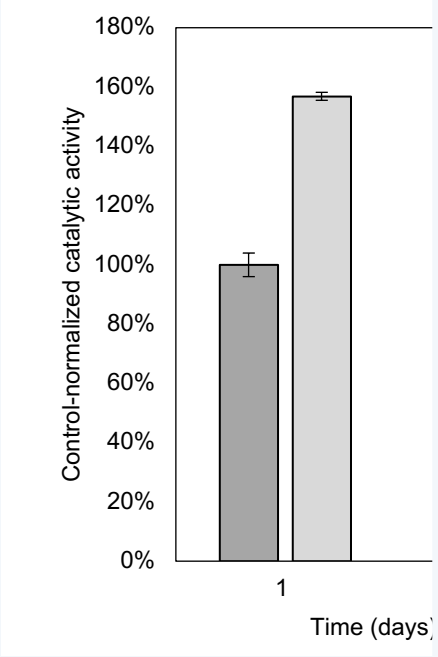
Biomass as Filler Alternative

Bio-catalytic coatings



Catalytic activity is stabilized by the incorporation of microbial cells into coatings compared to dried biomass alone over the course of 1 week

Skopp, A., et al., 2024, submitted

Bio-based Industries Consortium
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Summary

- Biomass can be used as extender alternative, but certain performance parameters need to be optimized
- Using microbial cells as platform for functionalization is possible
- Properties engineered into microbial biomass are imbued into the final coating in presented case studies

Next up: Greener Pigments

High Performance Bio-based Functional Coatings for Wood and Decorative Applications

Greener Ingredients

Scale up of precision fermentation for biobased ingredients

Stakeholder WS
2024-04-24

Anders Ødum – Chromologics Aps

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Chromologics-a sustainable production platform

Farmland

- Reduced need for farmland
- Independent of seasonality, climate

Flexibility

- Bioreactors allow for flexibility
- Production can be set up globally where is renewable energy is abundant and in proximity to costumers to reduces GHG footprint

Transparency

- Reliable supply chain and price stability
- Entire production can be done under one roof
- Transparent supply chain. Easy to monitor labor conditions and safety

Scale up of precision fermentation for biobased ingredients

1. Strain Engineering
Development of strains producing target product

2. Fermentation (UPS)
Target molecule is produced by the host during the fermentation process

3. Harvest and purification (DSP)
Downstream process includes purification, drying, and formulation

Scale up of precision fermentation for biobased ingredients

Specific **microorganism** that can produce product of interest.

Bacteria

Yeast

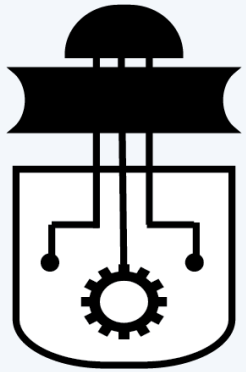
Filamentous Fungi

Process parameters that ensure high efficiency of product formation

Process conditions: pH & temperature

Media composition

Right process (Batch / Fed-Batch)



Contamination

Unwanted by-product formation upstream

Unwanted impurities in downstream

Easy and customized quality control points

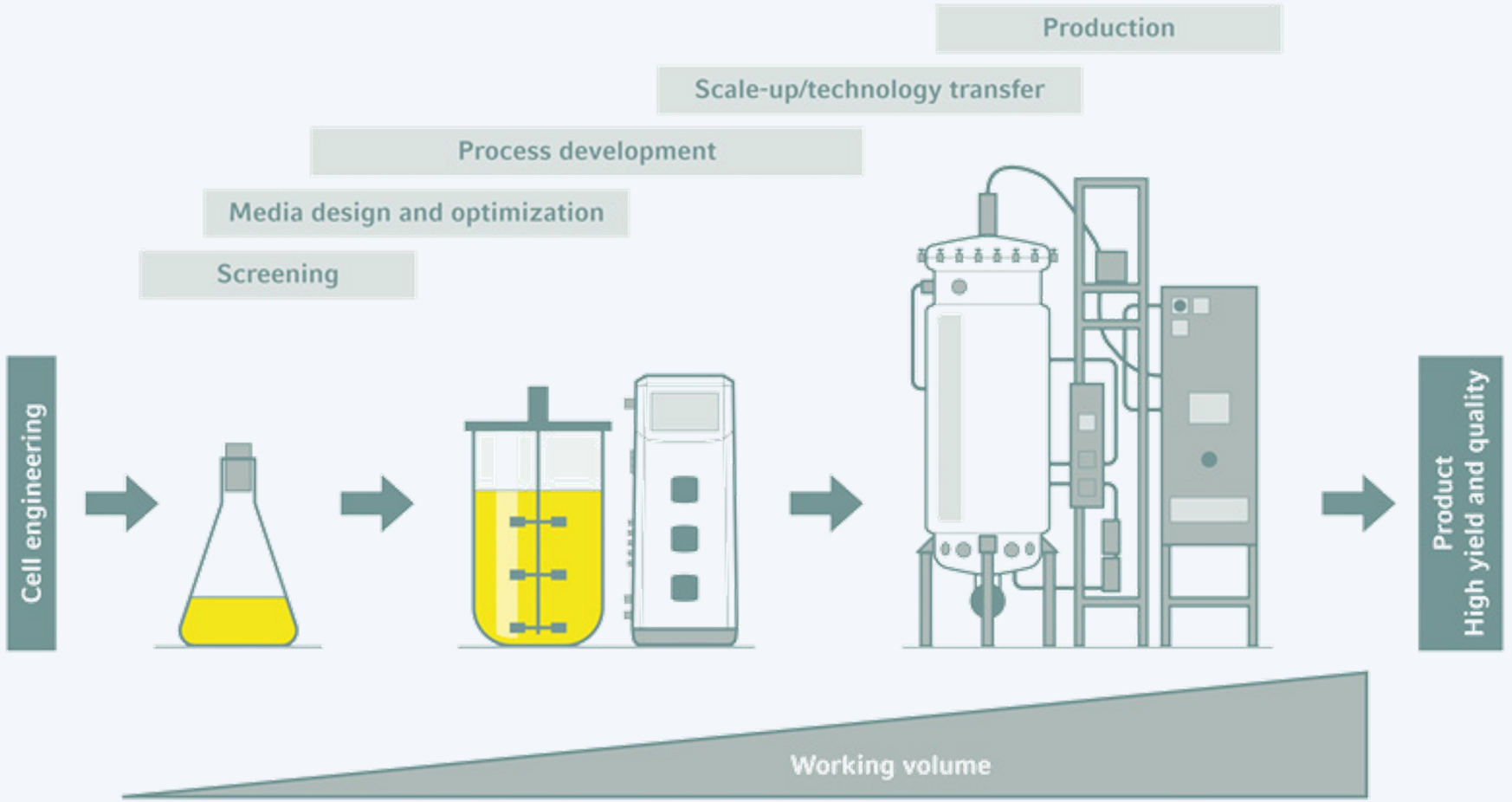
Waste stream utilization

Run on green energy

Scalability

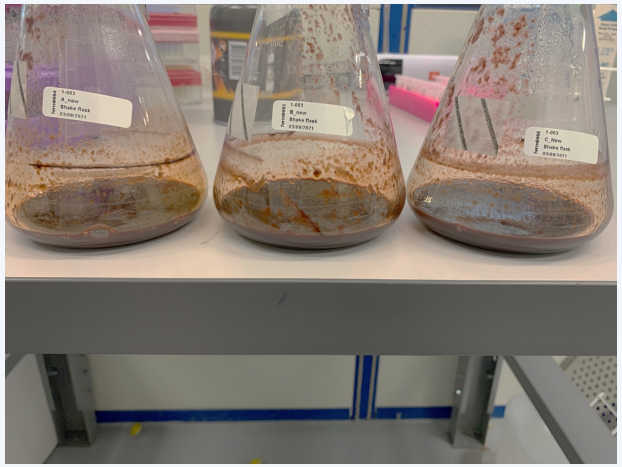
Sustainability profile

Scale up of precision fermentation for biobased ingredients



Scale up of precision fermentation for biobased ingredients

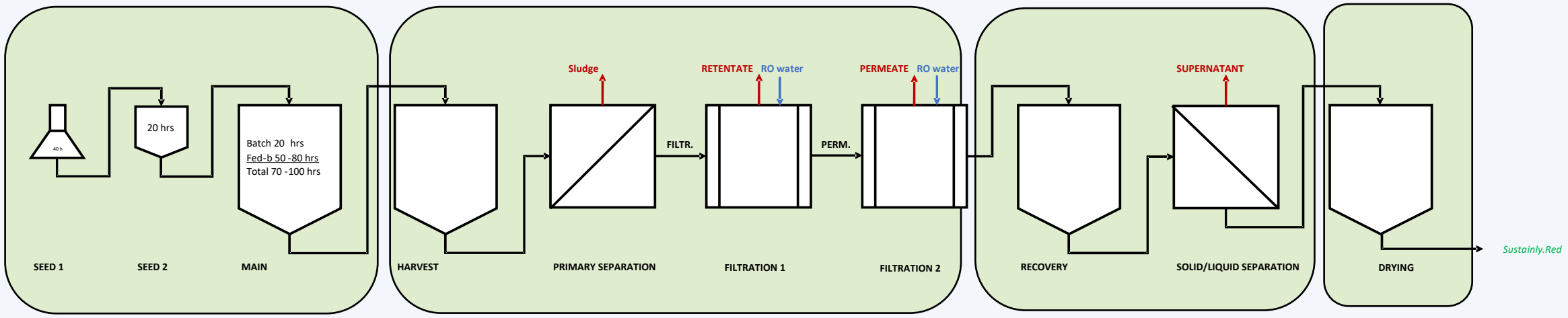
From Shake flask



To Seed

To production

Scale up of precision fermentation for biobased ingredients

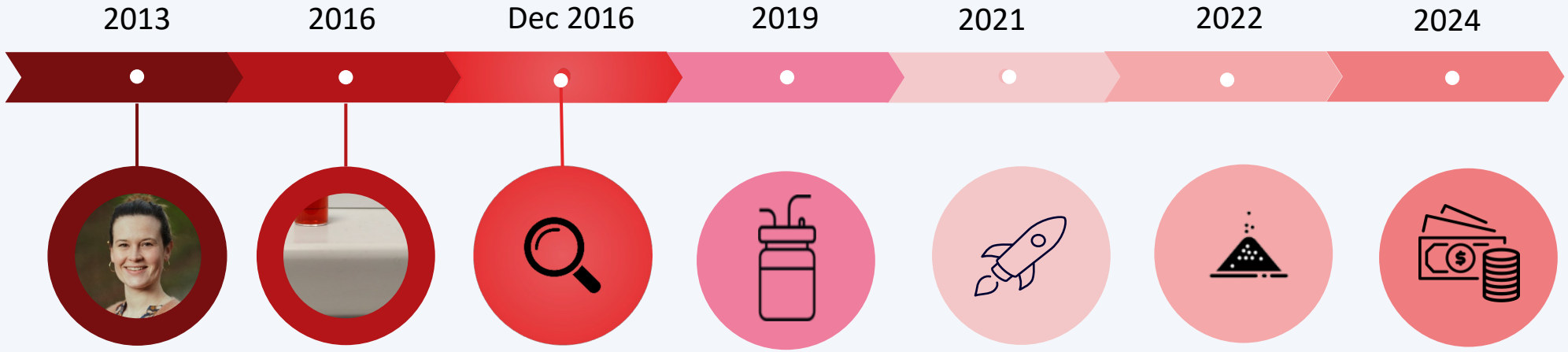


	Fermentation	Biomass removal and purification	Recovery	Drying
Time	5-7 days	2-3 days	1 day	2+ days

Process principles

- Fed-batch process
- Continuous process
- Decoupling point
- Multiple tanks may be required
- Pool batches to dry

Scale up of precision fermentation for biobased ingredients



Scale up of precision fermentation for biobased ingredients

Chromologics

Pioneering natural food colors

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Thanks for your attention