SSIA CONFERENCE - 2025

IO-COMPOSITES FOR SUSTAINABLE SEAWEED AQUACULTURE

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Substrate Materials Studied for Seaweed Attachment

- 1945 Glass Plates[1]
- 1973 Latex-rubber, sand, polyester resin[2]
- 1975 Concrete blocks[3]
- 1977 Metal, plexiglass squares, acrylic plates embedded with SiO2[4]
- 2018 Textile sheets[5]
- 2019 Polypropylene nets[6]
- 2022 Knitted fabric[7] Twisted yarn[8]
- 2023 Polyester, polypropylene, polyamide ropes Bio gears - Polylactic acid, Polybutylene succinate composites[9]
- 2024 Composite lines Fiberglass rods[10]

Material and Equipment Evaluation

❑ Ropes & Nets

- **Materials:**
  - Polypropylene
  - Polyester
  - Nylon
- **Benefits:**
  - Effective
  - Reliable
  - Versatile
- **Challenges:**
  - Plastic waste
  - Material degradation[7]

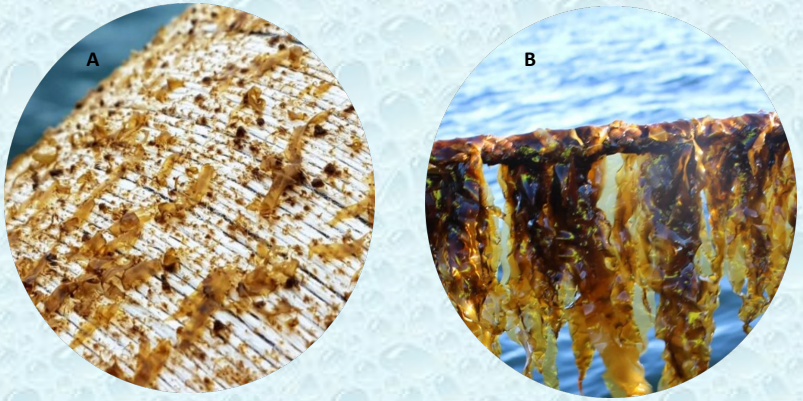

Figure 1: A: Seaweed Seedlings attached to twine B: Rope Deployed at sea
(©Lerøy Seafood Group)

Novel Initiatives for Seaweed Cultivation

Key Issues

- Ropes and Nets:
  - ✓ Strength degradation
  - ✓ Plastic Pollution
  - ✓ Poor seed attachment
  - ✓ Loss of harvest

Research Gap

- Limitations:
  - ✓ Lack of biodegradability
  - ✓ High-strength substrates optimised for seaweed growth

Proposed Solution

- PLA bio-composites:
  - ✓ Material strength
  - ✓ Strong bio-adhesion
  - ✓ Sustainable
  - ✓ Industrial compostable
  - ✓ Nutrient-rich harvest

Composite Production – Batch 1

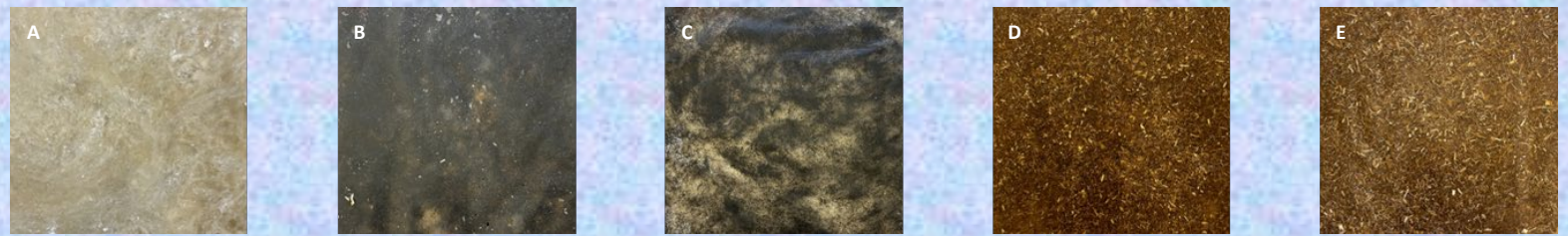

Figure 2: PLA Biopolymer Composites Reinforced with A: $CaCO_3$ (CC) ,B: Basalt Scales (BS), C: Basalt Filament (BF), D: Wheat Straw (WS), E: *Miscanthus* Straw (MS)

Visual Observations of Nursery Test

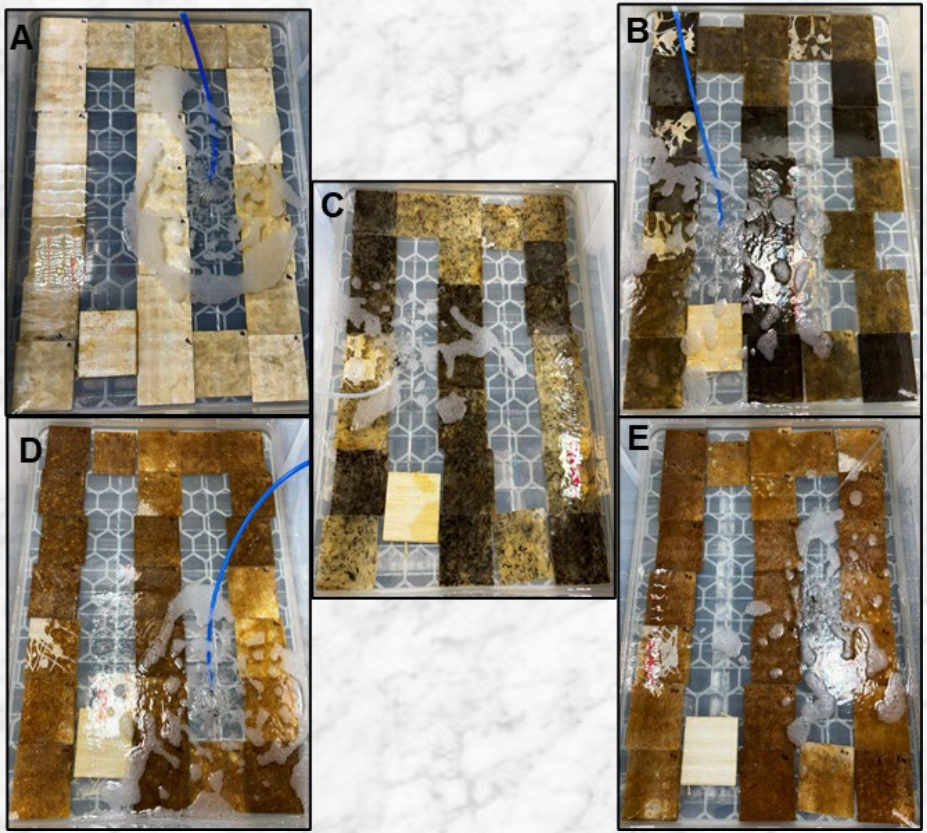

Figure 3: Nursery Tank Set up with Test Sample Plates (10 cm*10 cm) ; (A) $CaCO_3$,(B) Basalt Scales, (C) Basalt Filament, (D) Wheat Straw, (E) *Miscanthus* Straw . Tests conducted at Marine Laboratory, Queen's University of Belfast

Table 1: Nursery Test Results for Seaweed Adhesion (Highest Adhesion +++ / Moderate Adhesion ++ / Least Adhesion +) on the Composites Surface Untreated (SU) and Surface Sanded (SS)

Material	Formulation	Seaweed Adhesion
$CaCO_3$	3% SU	+++
	15% SU	+++
	3% SS	+++
	15 SS	+++
Twine (CC)	100%	+++
Basalt Scales	3% SU	++
	15% SU	++
	3% SS	++
	15 SS	++
Twine (BS)	100%	++
Basalt Filaments	3% SU	++
	15% SU	++
	3% SS	++
	15 SS	++
Twine (BF)	100%	++
Wheat Straw	3% SU	+
	15% SU	+
	3% SS	+
	15 SS	+
Twine (WS)	100%	+
Miscanthus Straw	3% SU	+
	15% SU	+
	3% SS	+
	15 SS	+
Twine (MS)	100%	+

Conclusion

- Filler and fibre reinforced PLA bio-composites were fabricated using the heat compression moulding technique as the manufacturing route.

- The nursery test results revealed that:
  - $CaCO_3$ composites showed the highest seaweed adhesion, while basalt reinforcements were moderate, and straw-reinforced composites were lowest, regardless of the material ratio.
  - Twine performance varied by tank conditions, with $CaCO_3$ tanks supporting the highest growth, while basalt tanks supporting the moderate and straw tanks supporting the lowest growth.
  - Sanded and untreated surfaces showed no significant difference in the early adhesion of seaweed seedlings in water medium without added nutrients.

Future Work

References

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THANK YOU

QUESTIONS?

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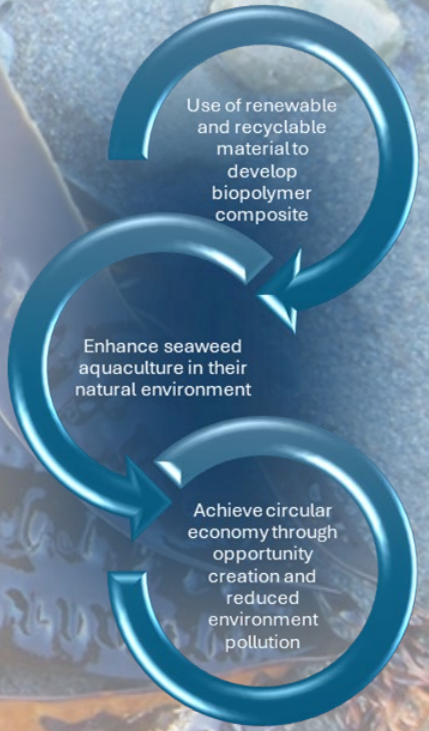

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