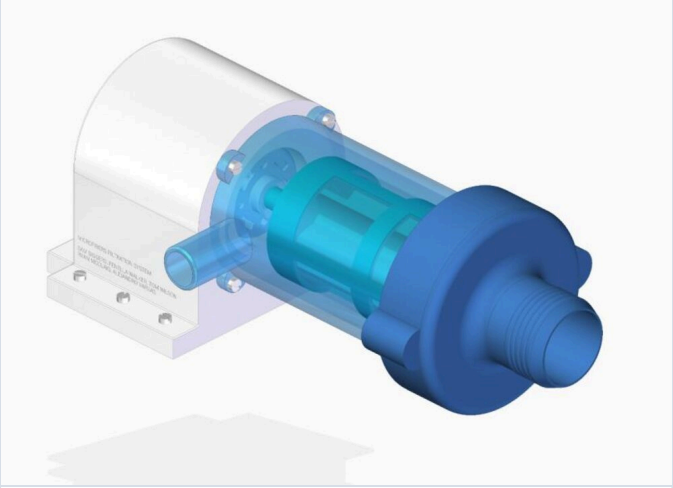
STUDY 04 · CONCEPT-TO-PROTOTYPE ARC · TEAM PROJECT, MY CONTRIBUTIONS LABELLED

The Oyster — microfibre filter

A washing-machine filter to capture clothing microfibres before they reach the ocean.

THE STUCK PROBLEM

Synthetic clothing sheds microfibres too fine for conventional filters, and the products on the market are external add-ons with limited capture. The brief: design a filter that integrates into the washing machine itself, captures around 90% of fibres, survives the machine's full service life, and needs minimal user maintenance.



Final CAD render — the spinning cylindrical filter integrated into a motor housing that mounts inside the machine.

The 3D-printed prototype — assembled unit, mesh cartridge, propeller insert, and the rig connected for testing.

MY ROLE ON THE TEAM

On a five-person team I owned the torque calculations, the stress and fatigue FEA, the final mesh selection, the prototype manufacturing, and a share of the concept sketching. Pump-blade design and the CFD flow study were led by teammates — noted where they connect to my work; the analysis and build below are mine.

THE CORE IDEA: SPIN THE FILTER TO MULTIPLY ITS AREA

Instead of passing flow through a filter set across the pipe — limited to the pipe's cross-section — spin a cylindrical filter so the flow is driven radially outward against the full cylinder wall. The effective filter area becomes the cylinder's *surface*, not its cross-section: far more area in the same space, a longer time before the mesh clogs, fewer user interventions. And the cylinder packs into the dead space behind the machine's existing service hatch, leaving the exterior untouched.

SIZING AND STRUCTURAL VALIDATION (MY WORK)

Mesh selection. A 25 µm nylon mesh, weighed against pore size, mechanical strength, cost and recyclability — nylon beat stainless on mass and recyclability while meeting

Drive sizing. Worst-case start-up torque sized the motor; the realistic case showed an inexpensive 12–18 V DC motor was sufficient, keeping cost and added power draw negligible.

FEA. Static and fatigue simulations on the outer case, inner case and propeller. The casing showed a large safety factor and a life far beyond the machine's — and the analysis singled out the inner-case shaft crossing as the weakest point.

BUILT AND TESTED

- 3D-printed working prototype, tested with real microfibre-laden water at a representative head height: **75.7% capture.**
- **Predicted failure, confirmed:** on a repeat run the printed shaft snapped — at exactly the location the FEA had flagged. Root cause: weak inter-layer shear from the print orientation. Fix: steel or a higher-modulus polymer, or injection moulding for the production part.

OUTCOME

A full arc from an open brief to a costed concept to a tested physical prototype — including a failure the analysis predicted and the test then confirmed. That agreement between model and reality, failure included, is the most useful result an early-stage study can produce.