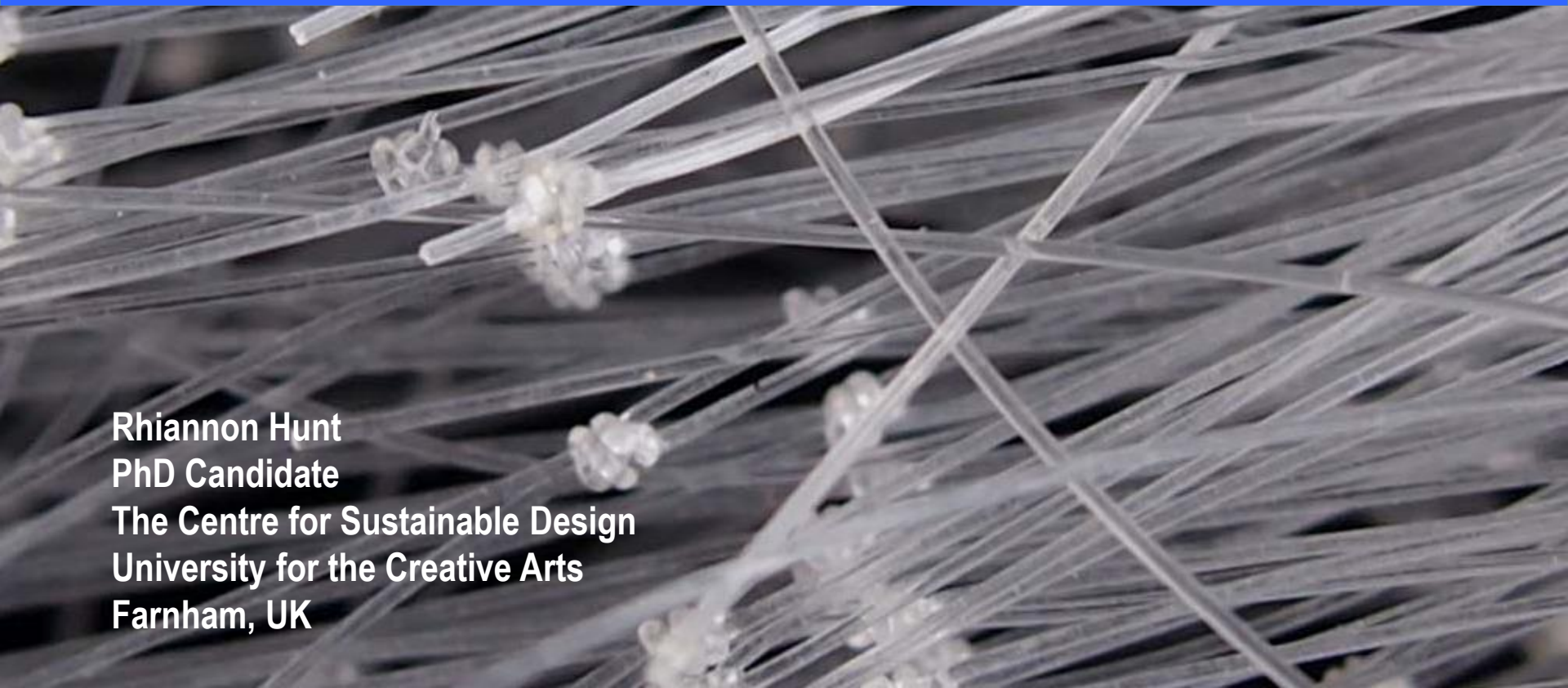
3D PRINTING APPLICATIONS FOR CREATING PRODUCTS MADE FROM RECLAIMED FISHING GEAR

SUSTAINABLE INNOVATION 2016



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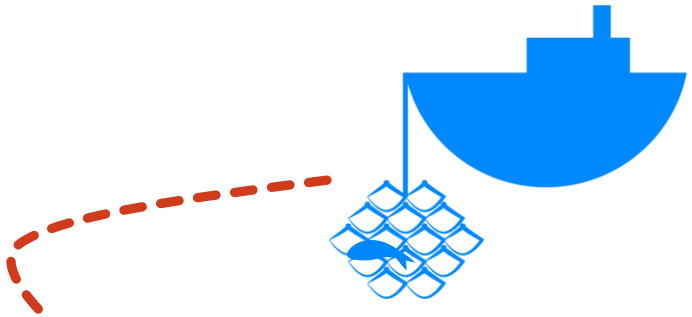
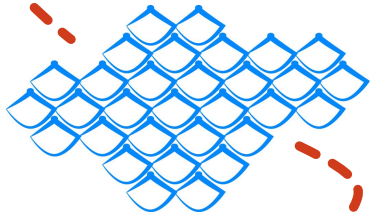
-THE PROBLEM-

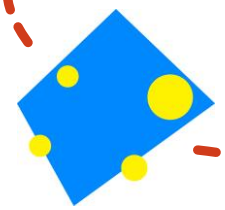


Nets are lost, abandoned or dumped at sea

Loss of material value for fishing communities

£ € $





‘Ghost nets’ continue to catch target and non-target species

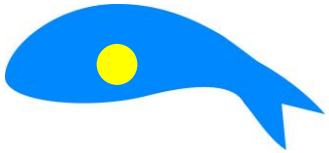
Chemical pollutants sorb onto net polymers

As they fragment, nets add to ocean plastic pollution

(Entanglement)

(Ingestion)

(Ingestion)



Fish kills

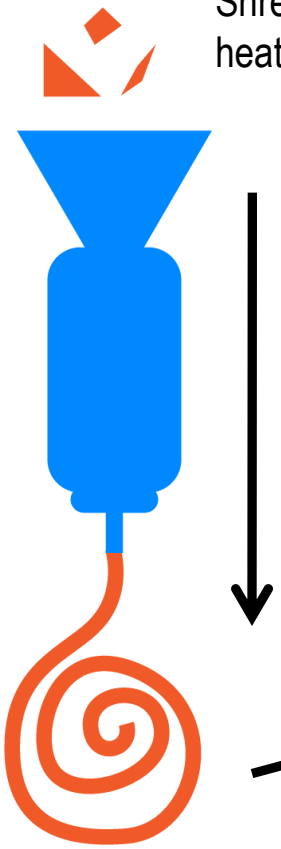
Contamination

Starvation

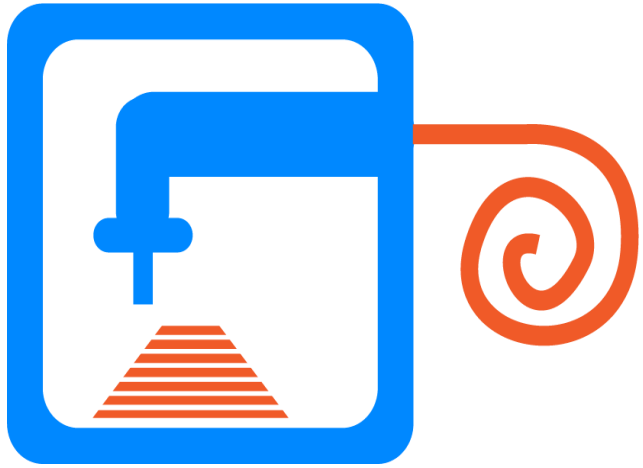
-THE SOLUTION?-

Waste fishing gear is collected, sorted, cleaned and shredded

Shredded material is heated and melt-extruded

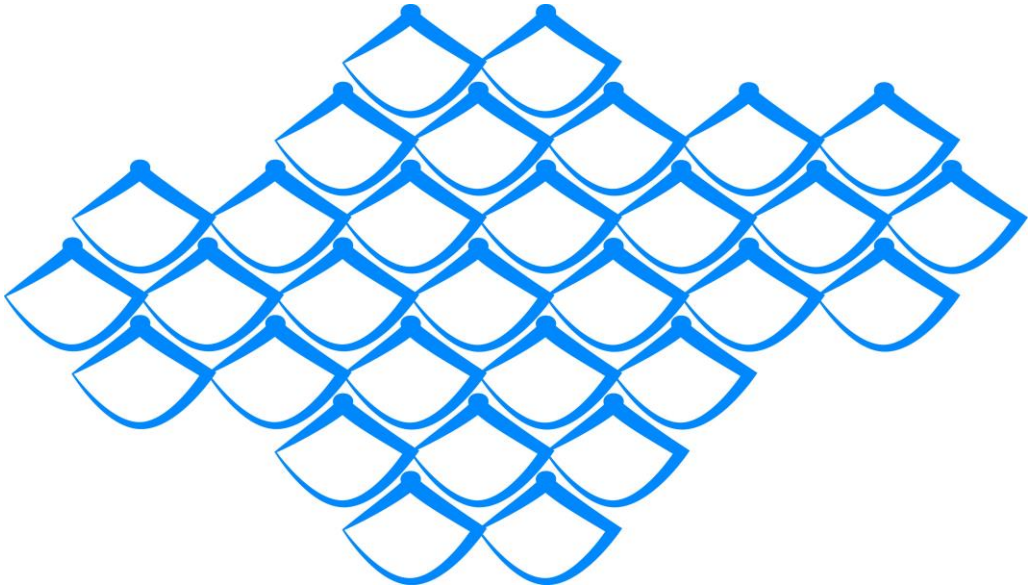


A spool of extruded filament is produced



Filament is 3D printed using a fused filament fabrication printer

-FISHING GEAR COMPOSITION-



- Thermoplastics
- High quality
- Mechanical strength
- Chemical resistance

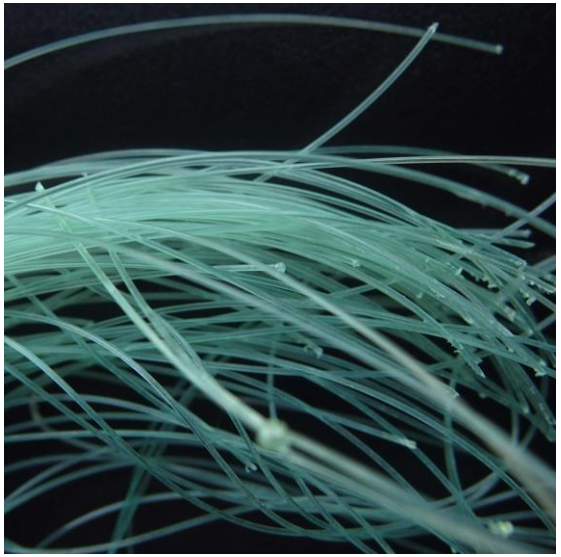
-FISHING GEAR COMPOSITION-

Polyethylene	Polypropylene	Polyester	Polyamide
• Moisture resistance • Chemical resistance • Impact resistance	• Moisture resistance • Chemical resistance • Fatigue resistance	• Moisture resistance • Chemical resistance • Durability	• Impact resistance • Chemical resistance • Tensile strength
• Poor UV resistance • Difficult to bond • Low melting point	• Poor UV resistance • Difficult to bond • Oxidative degradation	• Differential cooling rates can lead to warping	• High moisture pick-up • UV stabilisation required
• 3DP filament in development / DIY	• Limited 3DP filament availability / DIY	• 1.75mm & 3mm 3DP filament available	• 1.75mm & 3mm 3DP filament available
• Poor layer adhesion • Prone to warping • Burns above 80°C	• Prone to warping • Significant shrinkage during cooling	• Strength • High degree of clarity • No odours or fumes	• Strength • Interlayer adhesion • Prone to curling

-FISHING GEAR CONSTRUCTION-

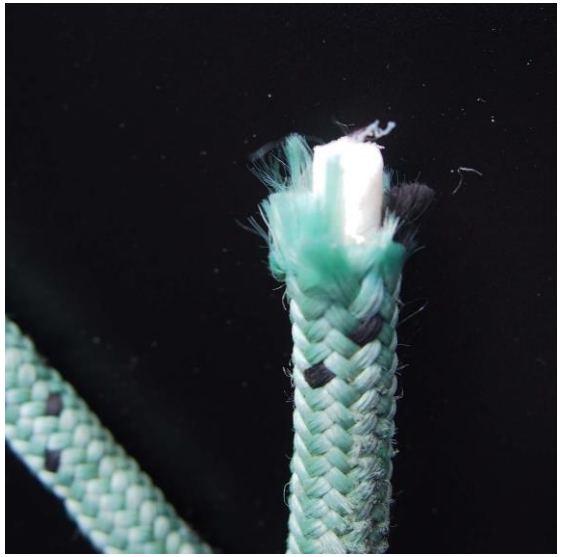
Single, twisted PE rope

Single, braided PE rope



Monofilament gillnet

-FISHING GEAR CONSTRUCTION-



Polyfoam and PE float-line

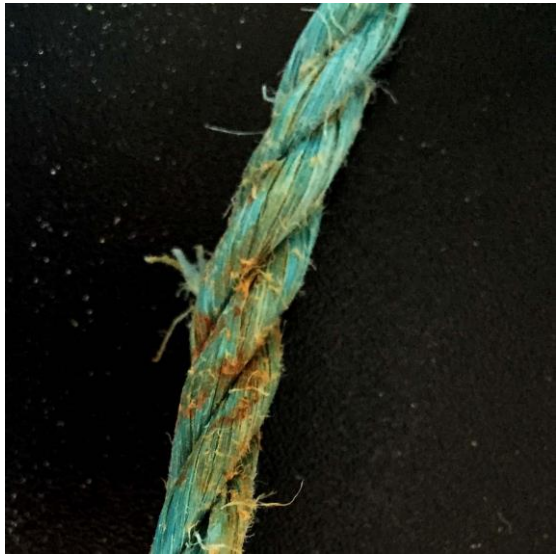
Braided PA stitched to PE rope

Adhesive tape on PE rope

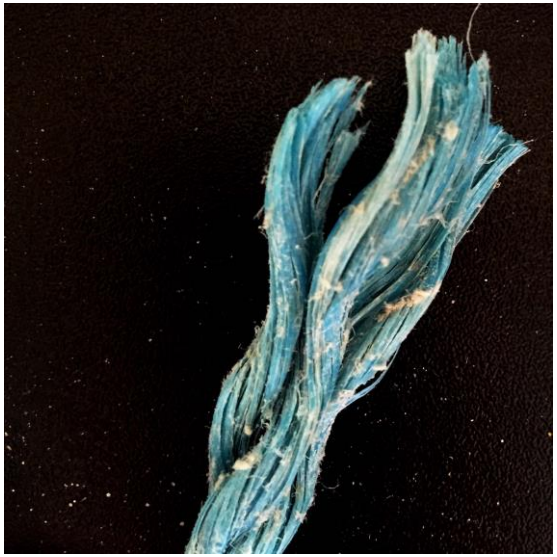
-FISHING GEAR CONDITION-

- Abrasion
- Absorption & adsorption of contaminants
- Ultra-violet degradation
- Chemical degradation

-FISHING GEAR CONTAMINATION-



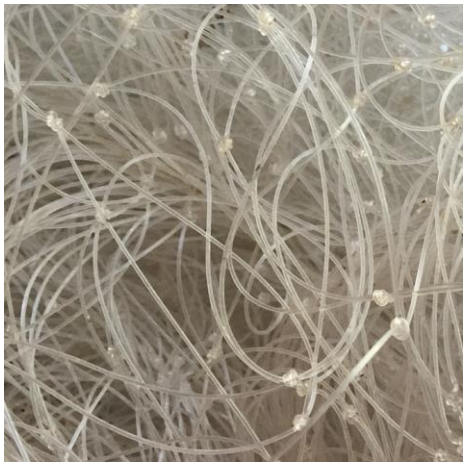
Suspected rust contamination



Salt and sand contamination

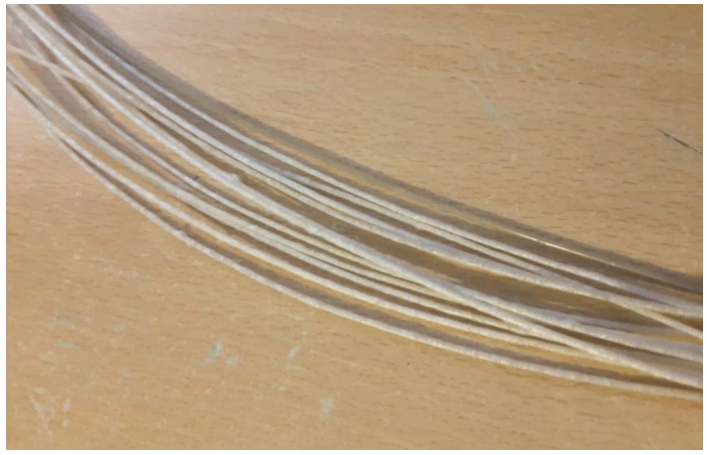
Suspected bio-fouling

-FISHING GEAR EXTRUSION TRIAL-



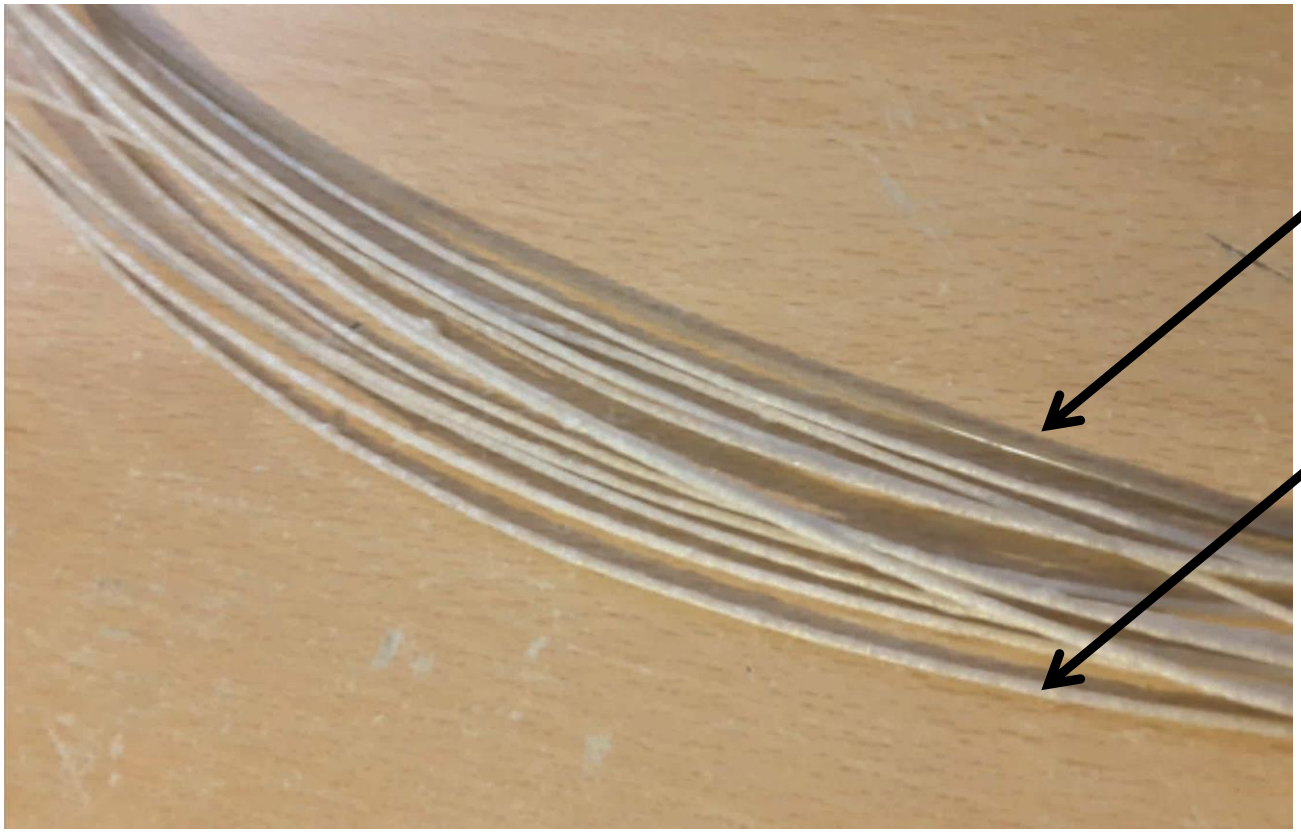
PA monofilament gillnet

Shredded PA <10mm



Extruded PA filament samples

-FISHING GEAR EXTRUSION TRIAL-



Slower, low temperature extrusion produced more consistent, high-quality filament

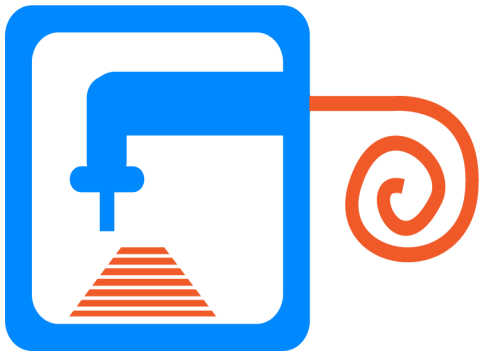
Bubbling due to high moisture content and high extrusion temperatures, creating steam

Salt contamination likely, however the extent and impact on filament quality is unknown

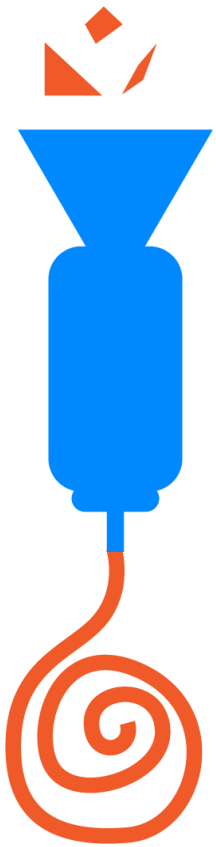
-FISHING GEAR EXTRUSION TRIAL-

Recommendations

- Polyamide monofilament gillnet is likely to be the easiest fishing gear to process and is likely to produce high quality 3D printing filament
- A mechanised shredding process is recommended as opposed to hand cutting the fishing gear ready for processing
- An industrial drying and pelletisation process is likely to produce higher quality filament, removing water content and ensuring a consistent composition and feed size
- Further testing to identify the level of salt contamination and it's impact on filament quality is needed
- Fused filament fabrication testing using a 3D printer to print products is needed



-3D PRINTING FILAMENT-



Clean, dry, pelletised polyamide fishing gear

Extrusion

Sale of filament

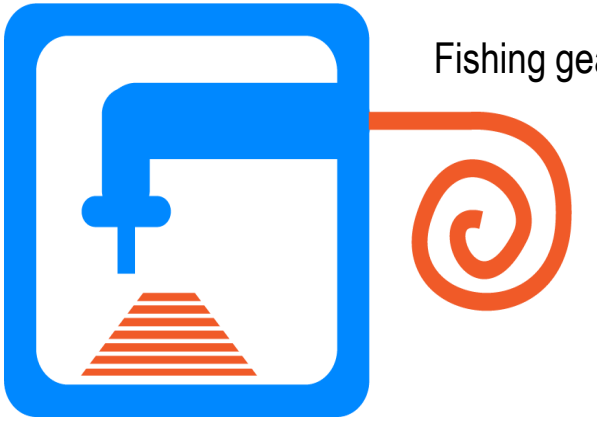
Positives

- Growing market for filament due to increasing popularity of fused filament fabrication (FFF) 3D printers
- Recycled filaments are now becoming available
- Potential for processing large quantities of fishing gear polymers into a valuable product, generating profits for local communities

Negatives

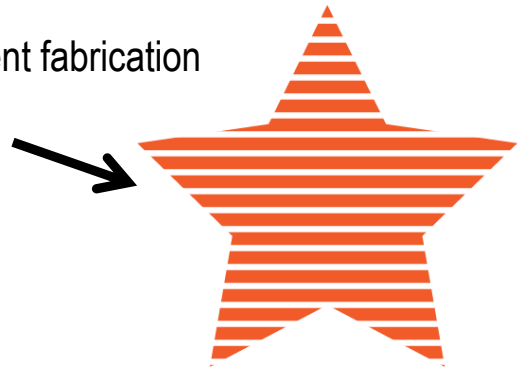
- Limited to particular fishing gear of the necessary polymer composition, quality and cleanliness
- Further testing needed to ensure recycled fishing gear filament produces quality 3D prints

-3D PRINTED PRODUCTS-



Fishing gear filament

Fused filament fabrication
3D printing



Sale of 3D printed product

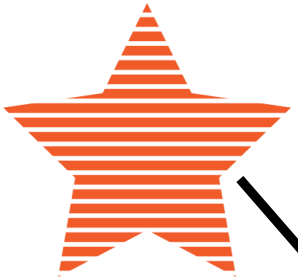
Positives

- Potential to add value through design and creativity

Negatives

- Limited to particular fishing gear of the necessary polymer composition, quality and cleanliness
- Further testing needed to ensure recycled fishing gear filament produces quality 3D prints
- Poor quality finish compared to other manufacturing processes (e.g. injection moulding)
- Limited by print-bed size and print speed
- Low volumes of fishing gear processed

-3D PRINTED PROTOTYPES-



3D printed prototype

Casting and injection moulding using fishing gear

Sale of injection moulded copies made from recycled fishing gear

Positives

- Potential to add value through design and creativity
- Makes the most of both 3D printing (flexibility, rapid prototyping) and injection moulding (quality, production speed)
- Potential to use a wider range of fishing gear polymers
- Potential for processing large quantities of fishing gear polymers into a valuable product, generating profits for local communities

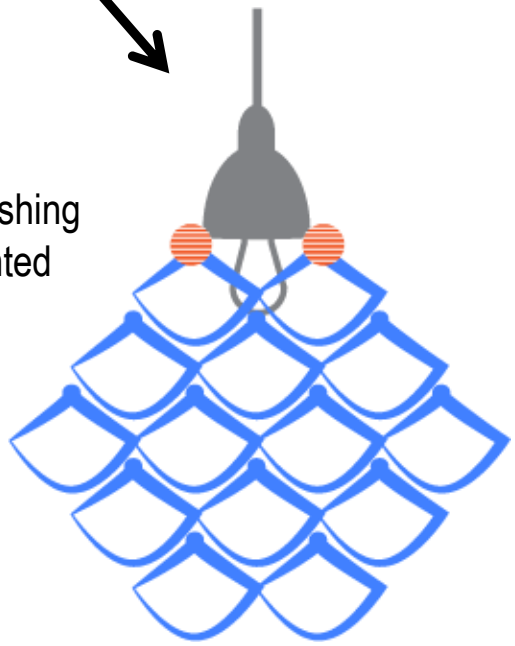
Negatives

- Set-up costs (equipment)

-3D PRINTED COMPONENTS-

3D printed components (e.g. clips)

Sale of products assembled from fishing nets using 3D printed components (e.g. lampshade)



Positives

- Potential to use any type of fishing gear polymer
- Potential for assembling large quantities of fishing gear into valuable products, generating profits for local communities
- Makes the most of 3D printing's flexibility to make custom components

Negatives

- Product designs are limited by the aesthetic of the existing fishing gear

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