Reuse of Waste Fishing Nets in Construction Materials

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Presentation outline

- The project ”Circular Ocean”
- Motivation
- Possible applications
- Methods
- Results
- Conclusion

Circular Ocean

ARTEK's role in Circular Ocean:

- Focus on the construction industry
- Methodology for properties of fishing nets
- Development of new applications
- Laboratory-scale testing of new solutions
- Pilot-scale testing in the NPA region

Motivation

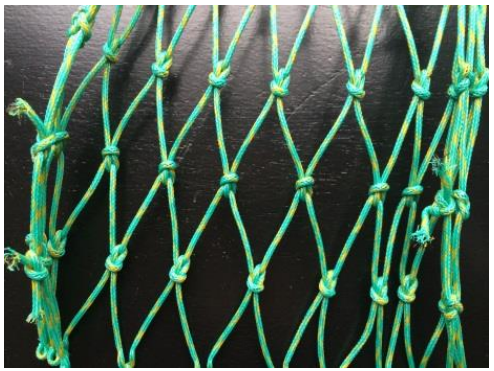
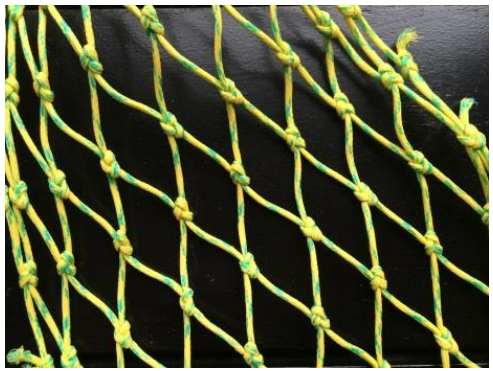
- Prevent marine plastic litter in the NPA region
- Reuse local waste materials from the fishing industry
- Find a proper application for waste nets in the construction industry

Introduction - Fishing nets

- Fishing industry in the NPA region
- Nets made of high density polyethylene (HDPE)
- Degradation due to abrasion, mechanical load, UV-radiation
- Waste fishing nets are stored at the dumpsite

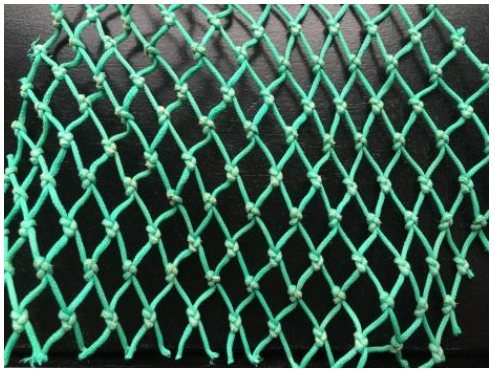
Introduction - Fishing nets

HDPE nettings from Greenland before use and after disposal


New nets





Waste nets

Possible applications – Fibre reinforcement

Why fibre reinforcing building materials ?

- **Primary fibres**: Flexural toughness, Post-crack performance
- **Secondary fibres**: Crack resistance, Shrinkage cracking, Durability

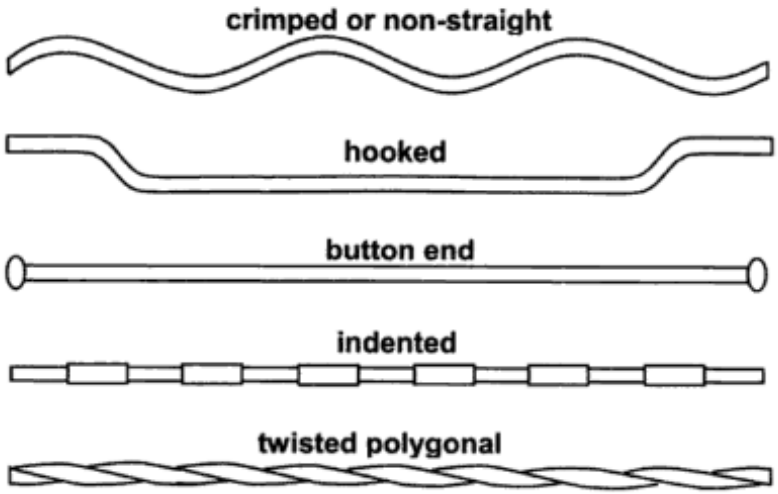
Plastic waste materials used as reinforcement of construction materials

- PET bottles, Textile carpet waste, Nylon fishing nets

Possible applications – Fibre reinforcement

Requirements for fibres as reinforcement

- Must be easily dispersed the mixture
- Must have suitable mechanical and bonding properties
- Must be durable in the environment of the material



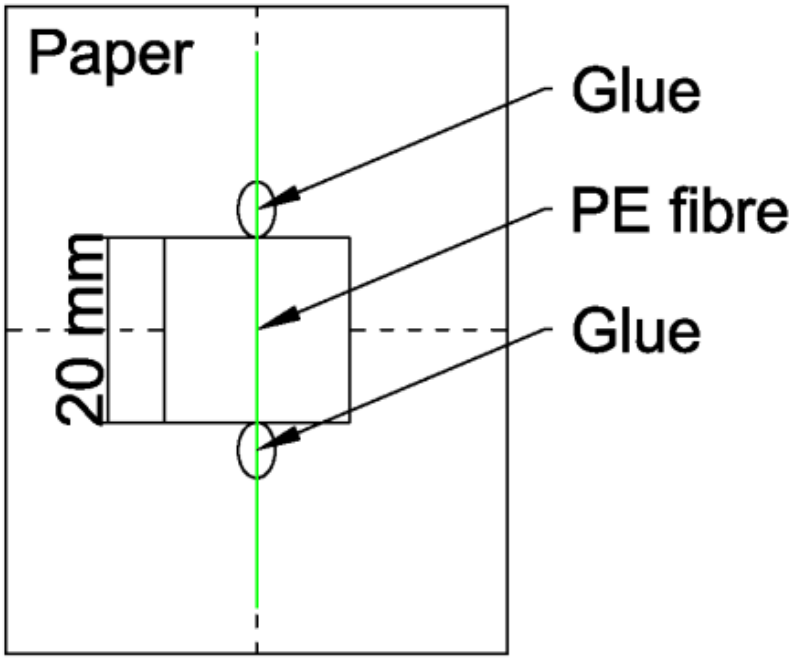
Methods – Engineering properties of fibres

- Comparison of fibres from new and waste nets
- Mechanical properties (tensile test)
- Durability properties (immersion in 1M NaOH for 28 days)
- Physical properties (SEM)
- Casting of material samples

Methods – Tensile testing

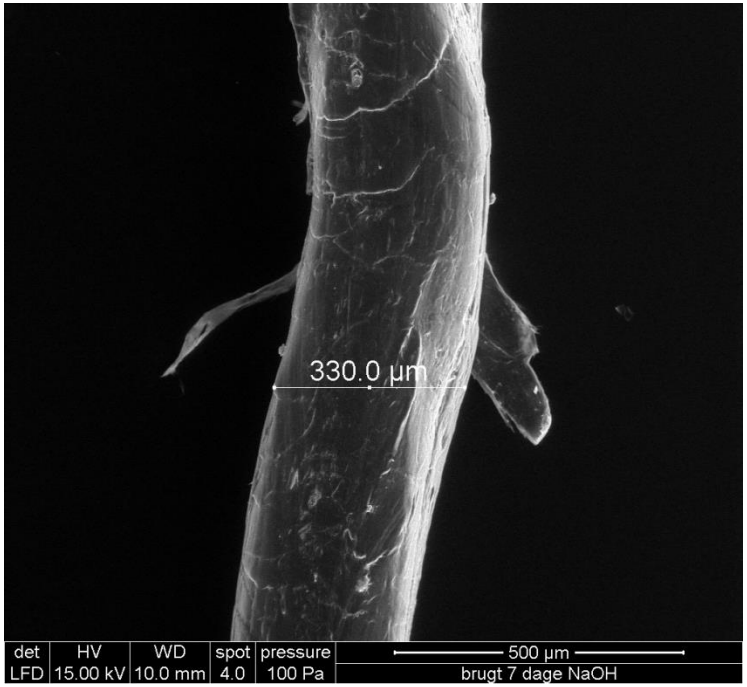
Tensile testing of single fibres on displacement-controlled Instron:

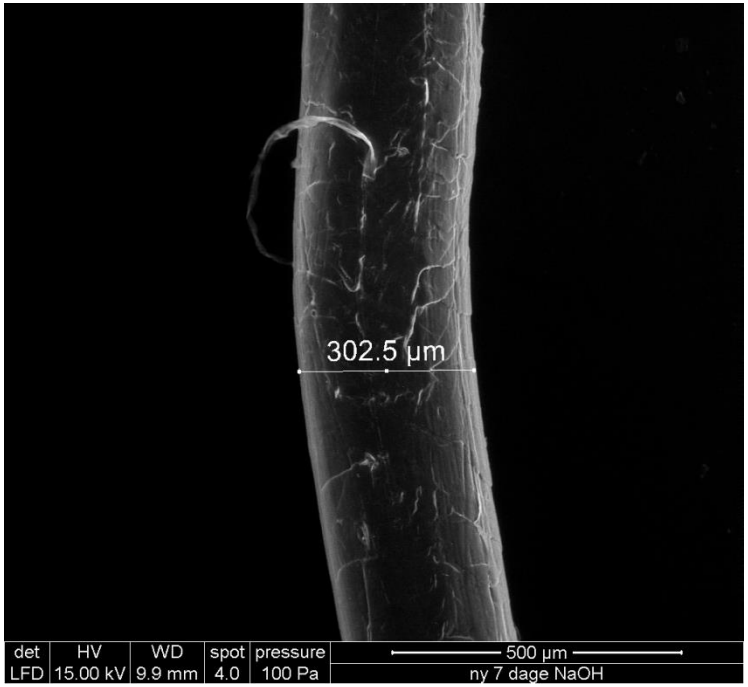
- Unconditioned/alkali-cured - new/waste fibres of HDPE



Results – Physical properties

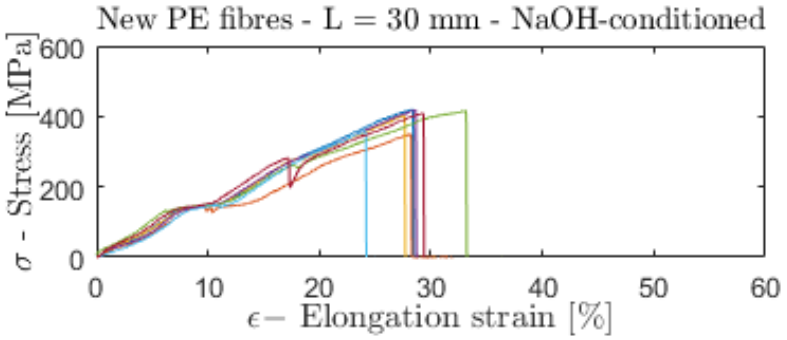
- Fiber diameter: d=270-330 µm
- Very smooth fibre surface

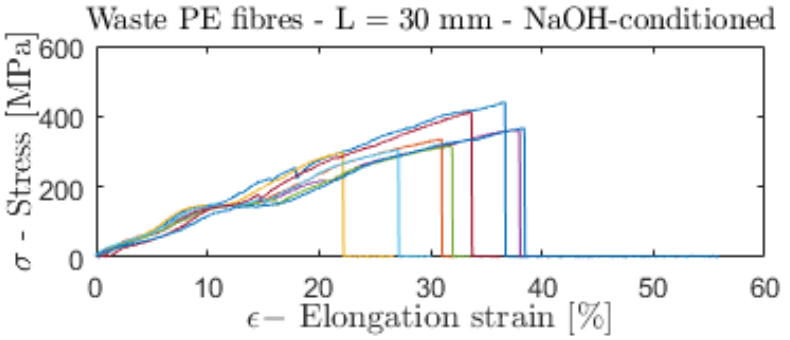




Results - Mechanical properties

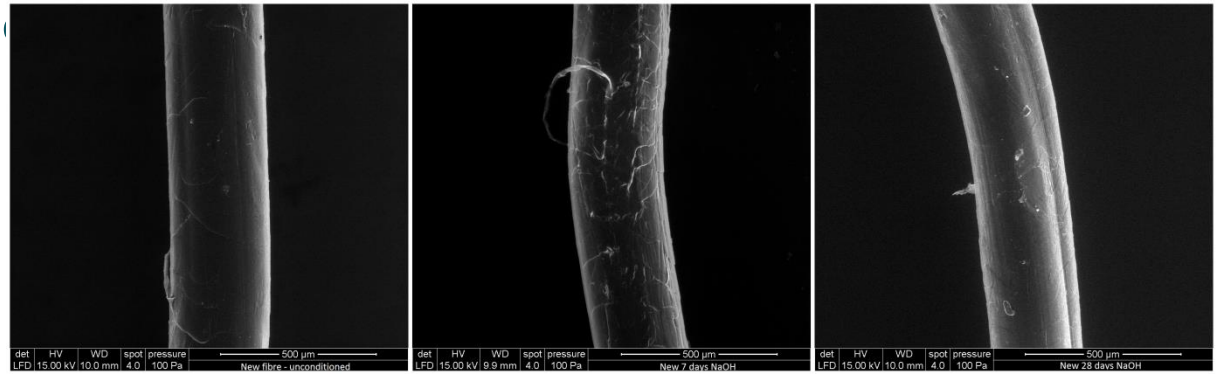
	Tensile stress σ [Mpa]	SD [-]	Tensile strain ε [%]	SD [-]	Young's modulus E [Mpa]	SD [-]
Unconditioned fibres						
New fibres	416	38.2	29.4	4.9	1454	293
Waste fibres	356	56.3	30.5	6.6	1199	218
NaOH-conditioned fibres						
New fibres	413	35.4	30.9	4.1	1351	138
Waste fibres	355	66.7	31.8	6.7	1127	125





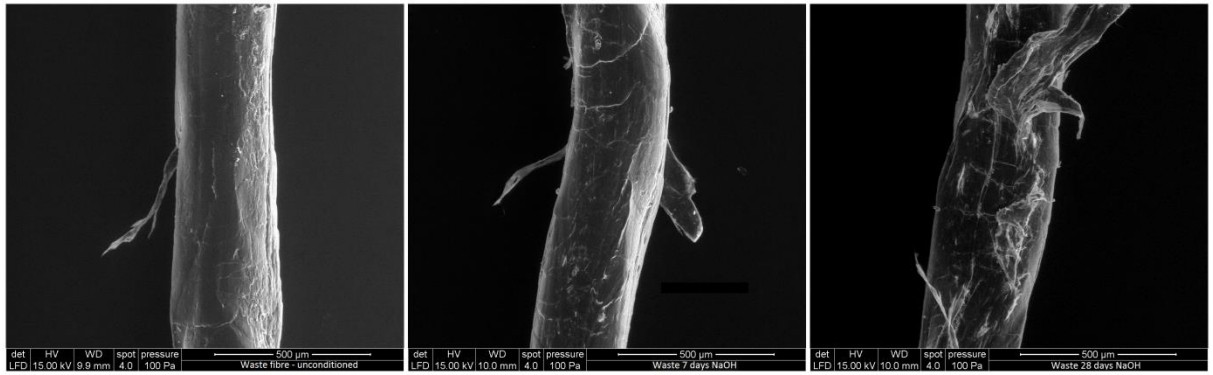
Results - Durability properties

- Immersion of fibres in alkaline solution (1M NaOH) for 7 and 28



(a) New fibre - unconditioned (b) New fibre - 7 days NaOH (c) New fibre - 28 days NaOH

New fibres



(a) Waste fibres - unconditioned (b) Waste fibres - 7 days NaOH (c) Waste fibres - 28 days NaOH

Waste fibres

Comparison with other fibres

- Suitable tensile strength
- Low stiffness
- Durable in an alkaline environment
- Smooth surface – poor bonding properties?

Next step:

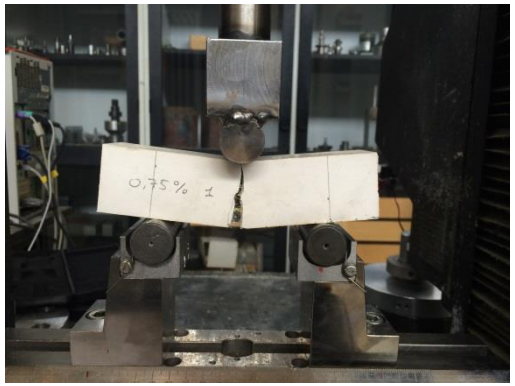
- Mix fibres into material mixture such as mortar, gypsum or clay
- Test bonding properties in different materials
- Evaluate composite materials

Methods – Casting of material samples

Fibre reinforcement of mortar, gypsum or clay samples

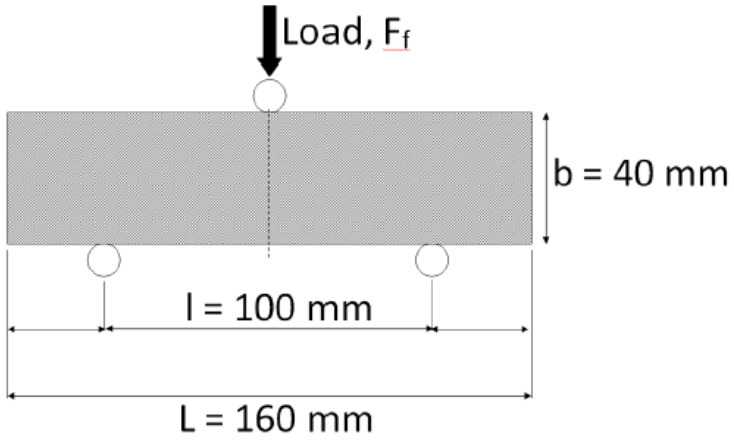




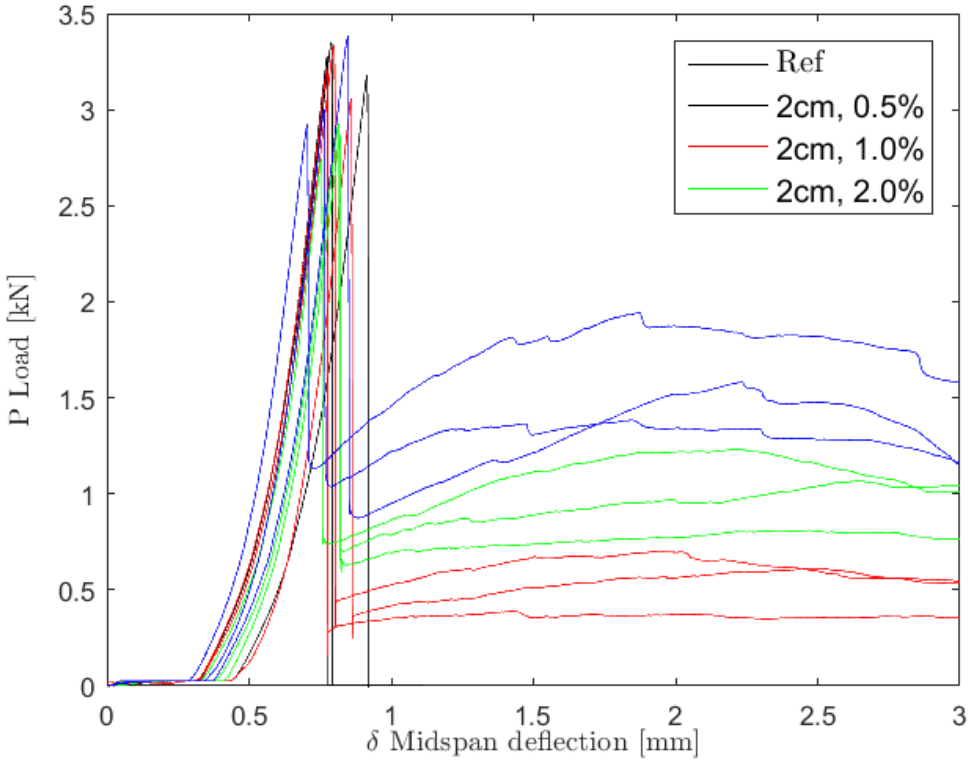


Results – Material samples

Test setup for 3-points bending



Force – deflection diagram



Possible applications

- Bigger parts of nets as reinforcement
- Geotextile under road – paved or unpaved
- Fibres in fired materials (bricks and tiles)
- Fire safety in concrete tunnels

Acknowledgement

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