TECHNICAL UNIVERSITY OF LIBEREC
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Enhancing geopolymer composites by recycled fibers

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1. Introduction

- Geopolymer composites can be enhanced by using chopped fibers.
- Recycled fibers are a reasonable choices from the economical viewpoint.
- The current work studied the influences of recycled fibers on the performance of geopolymer composites.

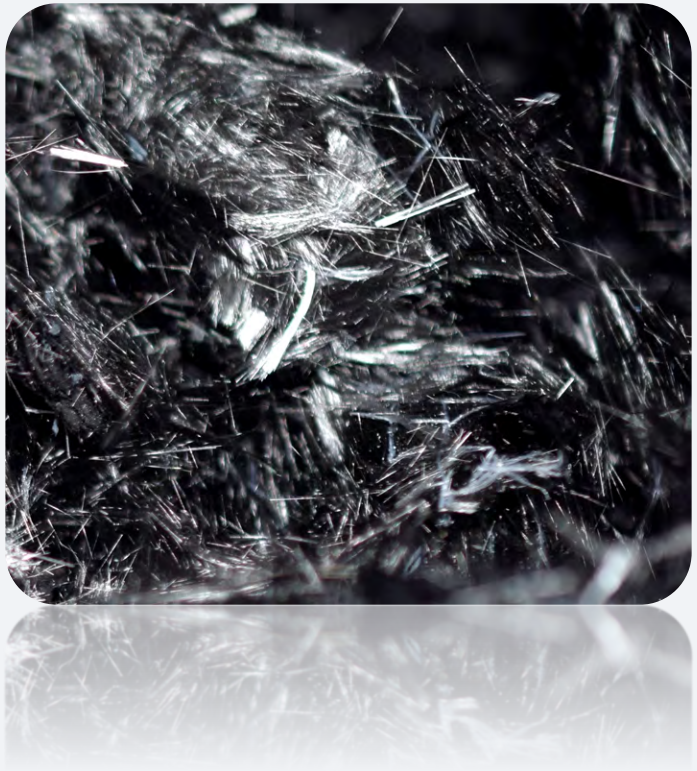
Why recycled carbon fibers?

- Recycled carbon fibers are about 2-3 times cheaper.
- The mechanical properties are mostly the same as the virgin carbon fiber.
- It is an environmentally friendly solution.

	Recycled carbon fiber (class 2.)	**Virgin carbon fiber**
Content of carbon fiber	>95%	100%
Density	1800 kg/m3	1780 kg/m3
Elastic modulus	>230 GPa	238 GPa
Tensile strength	>3500 MPa	3900 MPa

2. Objectives of the work

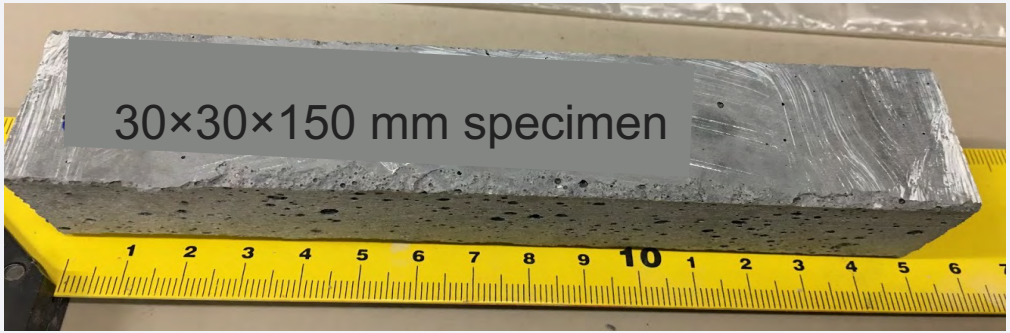
- Fibers: basalt, recycled carbon fibers: premium, class 1., class 2.
- Mechanical properties and physical properties
- Sand and fireclay were used as the major aggregates.



3. Methodology of the work

- Experimental study

Component	Ratio	Weight percentage
Metakaolinite (Mefisto L_{05} - Baucis lk.)	K	34.36
Potassium alkaline activator	0.9∗K	30.92
Silica Sand *or* Fireclay	1∗K	34.36
C-fiber/basalt	0.01∗K	0.35



Testing methods

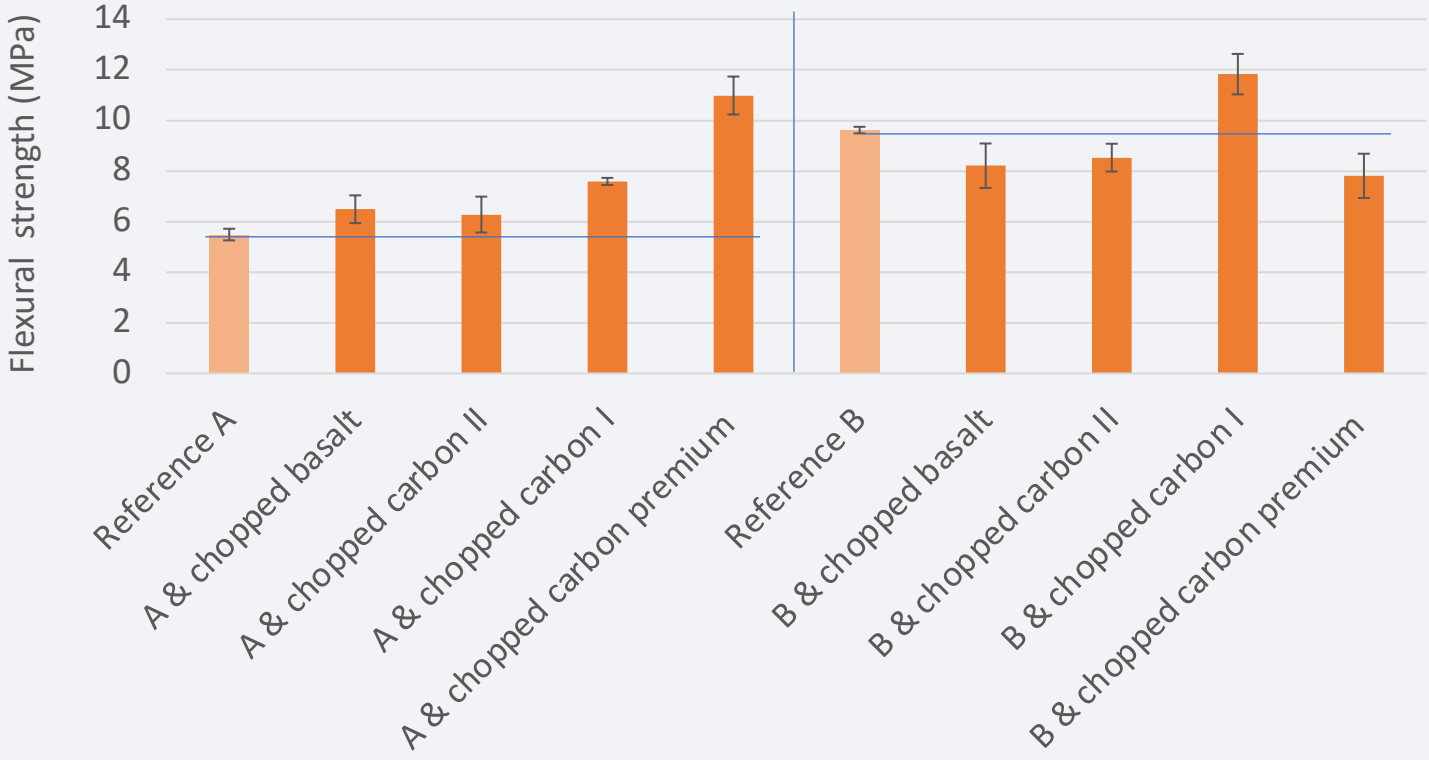
- Mechanical properties:
  Instron P100 LabTest II (model 4202)
  (EN 196-1)

- Thermal conductivity:
  Netzsch HFM 436 Lambda

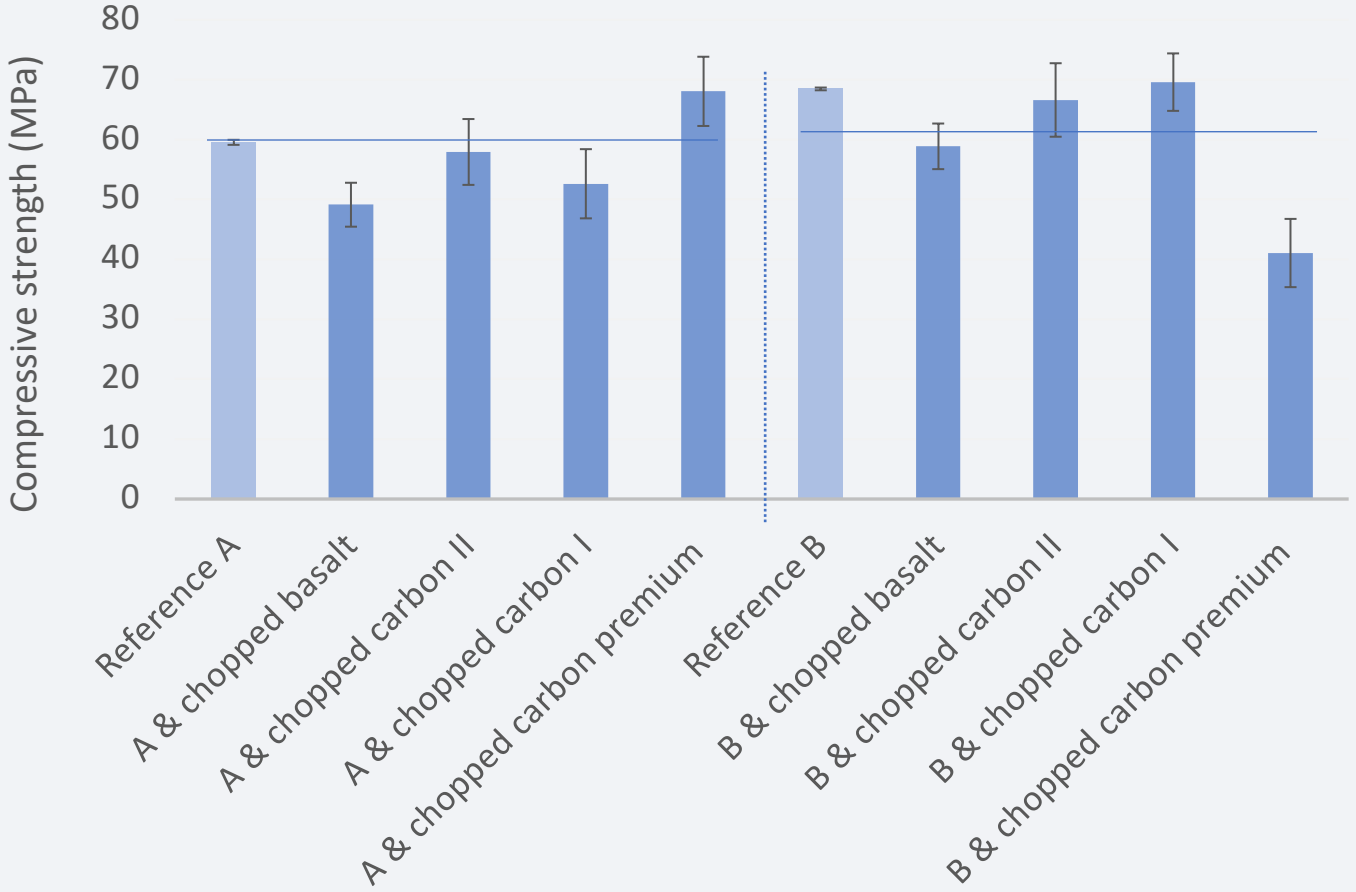
- Charpy impact test:
  Charpy machine PS 30

4. Results and discussions

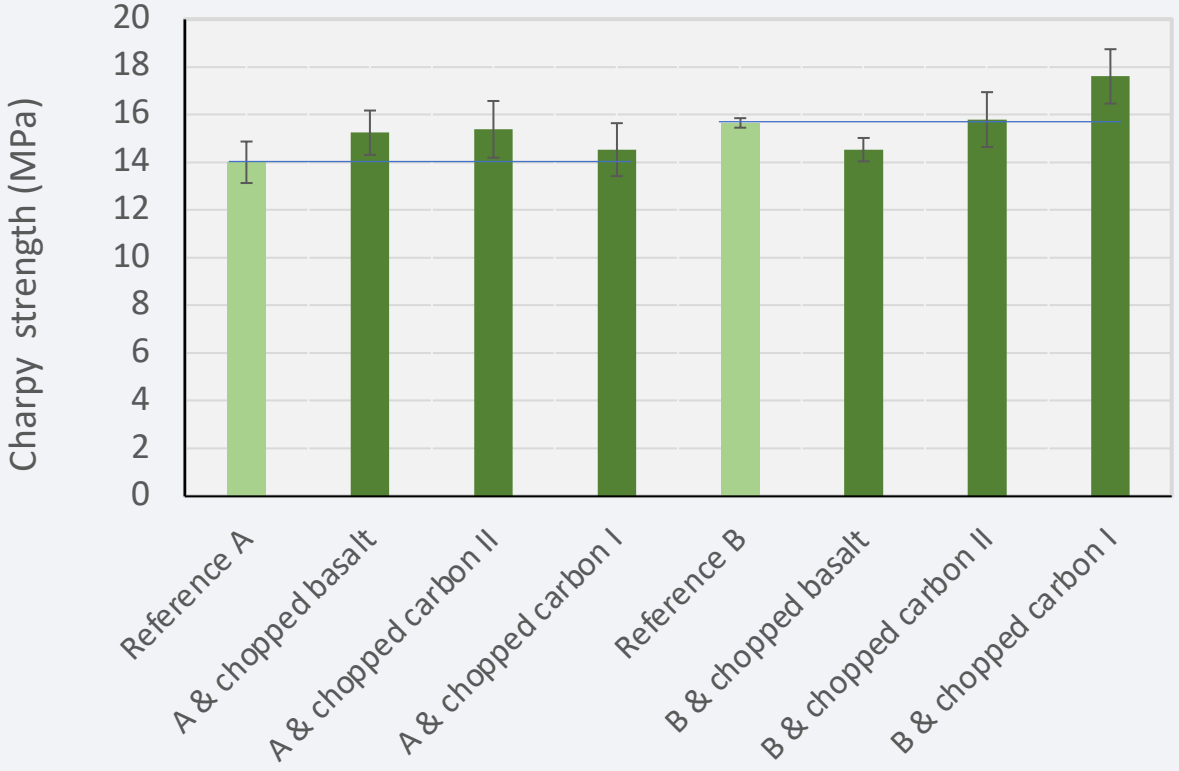
Flexural strength



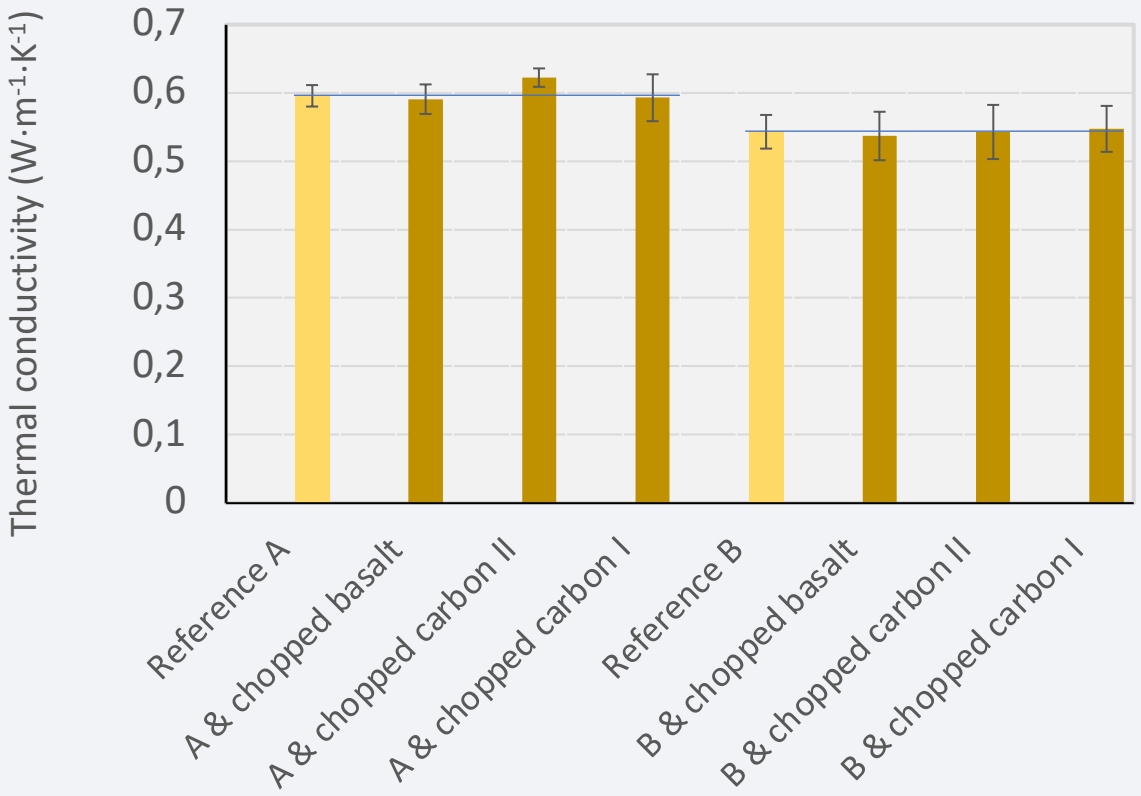
Compressive strength



Charpy strength test



Thermal conductivity



Fiber distribution in a sample

Conclusions

- The chopped fibers clearly enhanced the flexural strength of the geopolymer composites.
- The compressive strength was somewhat decreased (the present of fibers reduces the bonding between the aggregates and binder).
- The thermal conductivity did not significantly vary compared to the reference values.
- The fiber distribution influences the geopolymers' performance and the measuring accuracy.
- **Future work**: using recycled carbon fiber for electromagnetic shielding purpose, …

Thank you for your attention.

Composition of the used metakaolin

Chemical composition of Mefisto L_{05} (Baucis lk.)

Chemical composition	Al_2O_3	Fe_2O_3	TiO_2	SiO_2
Percentage	41.9%	1.1%	1.8%	52.9%

Typical properties:

- Workability at the temperature 20°C — up to 60 minutes (depends on ratio + type of filler)
- Maximum application temperature — 1200°C (depends on ratio + type of filler)
- Compressive strength after 28 days — min. 60MPa (depends on ratio + type of filler)
- Bending strength — 1^{st} day min. 3MPa, 7^{th} day min. 7MPa, 28^{th} day min. 11MPa (depends on ratio + type of filler)
- Resistance to temperature changes — very good (30 series -30°C +120°C; depends on ratio + type of filler)
- Shrinkage after 28 day at the temperature 20°C — max. 0,5% (depends on ratio + type of filler)
- Shrinkage after ignition 1000 °C — max. 2,0% (depends on ratio + type of filler)
- Density of geopolymer binder — 1,8 – 1,9 g/cm^3 (depends on ratio + type of filler)
- Efflorescence — minimal
- Color — grey