DELIVERABLES REPORT

MultiHemp

Multipurpose hemp for industrial bioproducts and biomass

(Ref n. 311849)

Task 6.6 Testing & Evaluation of biobuilding materials

Deliverables 6.8 & 6.10: Report on the performance of hemp building material

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Mark Hughes (Aalto University, Finland)

Aalto University
School of Chemical Technology

1. Introduction and current status of deliverables

A range of bio-based construction materials have been produced in the Multihemp project by partner 13 (C.M.F. TECHNOLOGY SPA). The product "Canapalithos®", which was produced in Task 5.2.2 from selected hemp varieties, has been and is being tested for certain physical and mechanical properties as well as performance characteristics. These properties include the following: Degree of humidity after acclimatization (equilibrium moisture content), Practical Moisture Buffering Value ($MBV_{practical}$), density, Modulus of Elasticity (MOE) Modulus of Rupture (MOR), internal bond strength (IBS), Thickness Swelling after 24 hours water immersion (TS), Dimensional Stability (DS); change in length and width due to humidity, coefficient of thermal dispersion, coefficient of resistance to vapour pressure, air penetrability, frost resistance, nail fixing and screw fixing as well as mould/fungal resistance.

Seven hemp-based building materials were received at Aalto University from partner 13 for testing in month 49. The first deliverable relating to this task was due month 42 (D6.8) and the follow-up (D6.10) in month 54. The latter relates to additional material yet to be received. Receipt of the panels in late September 2016 (M49) coincided with a significant infrastructure improvement project at Aalto University, department of Forest Products Technology, which caused further delays to the testing of the materials and consequently to the completion of deliverable 6.8. The infrastructure improvements are now largely complete, the samples for testing have been prepared and testing has begun and the first results have been obtained. At the time of writing, further samples are to be delivered in connection with deliverable D6.10 and additional tests in connection with D6.8 are ongoing. An updated deliverable report will be prepared when all remaining tests in connection with these deliverable have been completed.

2. Materials and Methods

Materials

Seven boards of the hemp-based building material (designated: ca0035 fibra, ca0035 canapulo, ca0050 canapulo, 500 canapulo, ca0050 fibra, 350 canapulo and 700 crossover), were machined into samples in order to carry out the tests listed below. Machining was carried out using standard equipment used to cut wood-based products such as solid wood, plywood and particleboard.

Methods

Where possible, testing is being / was carriesd out in accordance with EN standards. Due to the thickness and dimensions of the panels some alterations to the test were necesscary. The most relevant test standards relating to this work were:

- Modulus of Elasticity and Modulus of Rupture: EN-310: 1993: Wood-based panels: Determination of modulus of elasticity in bending and of bending strength (with modifications in the test setup)
- Internal bond stregnth: EN 319: 1993: Particleboards and fibreboards – Determination of tensile strength perpendicular to the plane of the board
- Density: EN-323: 1993: Wood-based panels – Determination of density
- Frost resistance: EN-321: 2002: Wood-based panels – Determination of moisture resistance under cyclic test conditions
- Swelling after 24 h water immersion: EN-317: 1993: Particleboards and fibreboards – Determination of swelling in thickness after immersion in water

- Practical Moisture Buffering Value: Moisture Buffering of Building Materials[1]
- Change in length and width due to humidity: EN-318: 2002: Wood-based panels – Determination of dimensional changes associated with changes in relative humidity
- Nail and screw holding EN 320: Fibreboards. Determination of resistance to axial withdrawal of screws (the standards will be modified for the tests)

3. Results and discussion

Results from the tests conducted according to EN-310: 1993: Wood-based panels: Determination of modulus of elasticity in bending and of bending strength are presented in Table 1. As may be seen, CA0050Canapulo exhibited the highest MOE value, closely followed by Canapulo500 and 700 crossover respectively. These materials also showed the greatest MOR values.

Table 1: MOE/MOR

Panel designation	MOE (kN/mm^2)	MOR (N/mm^2)
700 crossover	0.540	2.53
Canapulo500	0.559	2.33
Canapulo350	0.046	0.83
CA0050fibra	0.010	0.36
CA0050Canapulo	0.655	2.53
CA0035Fibra	0.155	0.30
Ca0050Canapulo	0.178	0.83

The whiter Crossover and Canapulo specimens exhibited a cleaner break in the middle of the specimens (Fig. 1), whilst the darker fibra specimens broke unevenly and randomly along the length of the specimen (Fig. 2). The fracture always proceeded diagonally between the granules of the material (Fig. 3). One of the ca0035fibra samples broke before testing began.

[1] Moisture Buffering of Building Materials (http://orbit.dtu.dk/fedora/objects/orbit:75984/datastreams/file_2415500/content)

Fig. 1

Fig. 2

Fig. 3