TABLES

Table 1. Statistical comparison (ANOVA) of the ratio of treated (T) and non-treated (NT) particles

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sieve size** | 1.2 mm | 1.0 mm | 0.5 mm | 0.4 mm | 0 mm |
| **P-value** | 0.2865 | 0.1381 | 0.7117 | 0.3465 | 0.1591 |
| **F/F crit\*** | 0.1959 | 0.4436 | 0.0204 | 0.1474 | 0.3873 |

\*the relation between estimated F value and critical F value in ANOVA test

Table 2. Characteristics of nontreated (NT) and treated (T) beech particles with the results of statistical analysis (ANOVA)

|  |  |  |
| --- | --- | --- |
| **Component** | **Content [%]** | **Statistical analysis NT/T** |
| **NT** | **T** | ***P*-value** | ***F*/*F* crit\*\*\*\*** |
| **Cellulose** | 41.12 ± 0.46 | 45.34 ± 1.24 | 0.0053 | 3.9485**\*\*\*** |
| **Klason's lignin** | 21.88 ± 0.19 | 22.05 ± 1.00 | 0.7833 | 0.0112 |
| **Acid-soluble lignin** | 1.37 ± 0.05 | 1.63 ± 0.28 | 0.1827 | 0.3362 |
| **Total lignin** | 23.25 ±0.20 | 23.68 ± 0.20 | 0.3867 | 0.1222 |
| **Extractives in hot water** | 3.96 ± 0.57 | 2.07 ± 0.34 | 0.0078 | 3.1722**\*\*\*** |
| **Extractives (toluol/ethanol)** | 2.87 ± 0.12 | 3.37 ± 0.19 | 0.0199 | 1.8271**\*\*\*** |
| **Ash (mineral content)** | 1.25 ± 0.41 | 0.75 ± 0.36 | 0.1864 | 0.3290 |
| **Others\* (supplement to 100%)** | 27.55 | 24.79 | / | / |
| **EMC\*\*** | 9.94 ± 0.14 | 10.27 ± 0.14 | 0.0150 | 1.8949**\*\*\*** |

\*including hemicelluloses; \*\*after conditioning of samples (68 %, 20.1 °C); \*\*\*denotes a statistically significant difference at the confidence level of 95 %; \*\*\*\*the relation between estimated F value and critical F value in ANOVA test

Table 3. Elemental composition and the heating value of nontreated (NT) and treated (T) beech particles

|  |  |  |  |
| --- | --- | --- | --- |
| **Sample\*** | **Element content [% by wight]** | **C/O ratio \*\*\*** | **Higher Heating value [MJ/kg]** |
| **C** | **H** | **N** | **O\*\*** |
| **NT** | 46.94 ± 0.09 | 6.14 ± 0.05 | 0.17 ±0.04 | 45.49 ± 0.16 | 1.03 ± 0.01 | 18.131 ± 0.073 |
| **T** | 47.59 ± 0.06 | 6.58 ± 0.06 | 0.23 ± 0.02 | 44.86 ± 0.07 | 1.06 ± 0.01 | 18.580 ± 0.088 |

\*state of the equilibrium moisture content; \*\*calculated value; \*\*\*carbon-to-oxigen ratio

Table 4 . Physical and mechanical properties of PNT, PT 10 and PT 20 pellets (numbers after the ± represents the standard deviation

|  |  |  |
| --- | --- | --- |
| **Property** | **Sample** | **Test Method** |
| **PNT** | **PT 10** | **PT 20** | **A1 class** |
| **Diameter, mm\*,\*\*\*** | 6.34 ± 0.11 | 6.07 ± 0.04 | 5.95 ± 0.18 | 6 - 8 (±1) | EN 16127 |
| **EMC, %\*,\*\*\*** | 10.40 ± 0.21 | 7.08 ±0.17 | 10.60 ± 0.23 | / | / |
| **Diameter change. %\*\***  | 2.39 ± 0.46 | 1.47 ± 0.30 | 2.38 ± 0.52 | / | / |
| **Bulk density,kg/m3 \*\*\*** | 605.13 ± 4.37 | 729.63 ± 8.57 | 667.11 ± 4.84 | 750≥BD≥600 | EN 15103 |
| **Pellet density, kg/dm3 \*** | 1.21 ± 0.05 | 1.40 ± 0.05 | 1.27 ± 0.06 | ≥ 1.12 | EN 15150 |
| **Mechanical durability, %\*\*\*\*** | 98.79 | 96.73 | 98.74 | ≥ 97.5 | EN 15210-1 |

\*after conditioning (68 %, 20.1 °C); \*\*after drying of conditioned pellets until constant mass (103±2°C); \*\*\*[50]; \*\*\*\*percentage of initial particles (pellets)

Table 5. Statistical comparison of physical properties of PNT, PT 10 and PT 20 pellets

|  |  |  |  |
| --- | --- | --- | --- |
| **Compared sample groups** | **PNT/PT 10** | **PNT/PT 20** | **PT 10/PT 20** |
| **Property** | **P-value** | **F/F crit** | **P-value** | **F/F crit** | **P-value** | **F/F crit** |
| **Diameter** | 1.71 10-6 | 10.9468\* | 2.18 10-5 | 7.3116\* | 0.05874 | 0.9227 |
| **EMC** | 8.21 10-18 | 318.0246\* | 4.6001 | 0.7068 | 4.52 10-16 | 293.5752\* |
| **Diameter change** | 0.0002 | 5.2842\* | 0.9598 | 0.0006 | 0.0003 | 4.5797\* |
| **Bulk density** | 2.35 10-5 | 65.1566\* | 7.96 10-5 | 35.1770\* | 0.00039 | 15.7064\* |
| **Pellet density** | 1.63 10-7 | 16.1676\* | 0.0262 | 1.3324\* | 0.00014 | 5.5154\* |

\*denotes a statistically significant difference at the confidence level of 95 %

Table 6. Elemental composition of PNT, PT 10 and PT 20 pellets

|  |  |  |
| --- | --- | --- |
| **Pellet sample**\* | **Element content [% by weight]** | **C/O ratio\*\*\*** |
| **C** | **H** | **N** | **O**\*\* |
| **PNT** | 47.60 ± 0.07 | 5.68 ± 0.10 | 0.19 ± 0.02 | 45.21 ± 0.05 | 1.05 ± 0.01 |
| **PT 10**  | 50.11 ± 0.06 | 5.48 ± 0.09 | 0.17 ± 0.02 | 43.24 ± 0.07 | 1.16 ± 0.01 |
| **PT 20**  | 48.15 ± 0.08 | 5.91 ± 0.12 | 0.16 ± 0.03 | 44.70 ± 0.21 | 1.08 ±0.01 |

\*state of the equilibrium moisture content; \*\*calculated value; \*\*\*carbon-to-oxygen ratio

Table 7. Heating values and ash contents in PNT, PT 10 and PT 20 pellets [50]

|  |  |  |  |
| --- | --- | --- | --- |
| **Property** | **Sample** | **Classes** | **Method** |
| **PNT** | **PT 10** | **PT 20** | **A1** | **A2** |
| **Heating value, MJ/kg** | 18.266 ± 0.099 | 19.332 ± 0.253 | 18.445 ± 0.218 | 16.3 ≤ Q ≤ 19 | EN ISO 18125 |
| **Ash content, %** | 1.32 ± 0.14 | 1.00 ± 0.24 | 1.08 ± 0.08 | ≤ 0.7 | ≤ 1.5 | EN 14775 |