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FIRUZ FEVZI

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EDITORS

Dr. Assadullah ZIA

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Kabul Local Time: 14³⁰-17⁰⁰



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THE ENVIRONMENTAL SAFETY LEVEL INCREASING OF OIL STORAGE SYSTEMS

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ABSTRACT

The actual problem today is to ensure the reliability of operation and trouble-free operation of oil storage systems. One of the main causes of explosions and fires in oil storage tanks (reservoirs) is the static electricity generated in the pipeline during the oil transportation. The properties of composites and nanocomposites with disordered systems of carbon fiber inclusions, which could be used to neutralize static electric charges that occur in oil storage facilities and could lead to emergencies, have been investigated.

Similar to the study of matrices with cylindrical inclusions, the nanocomposites analysis with filler in the partially ordered longitudinal carbon fibers form has been performed [1–4]. Carbon nanofibers located along the entire length of the matrix, have the diameter of 1 nm, and 10 degrees of the maximum allowable deviation from the main axis. The volume fraction of inclusions from 0,025 to 0,25 has been analyzed. The calculated models of the nanocomposite with the volume fraction of inclusions equal to 0,2 have been presented on Fig. 1.

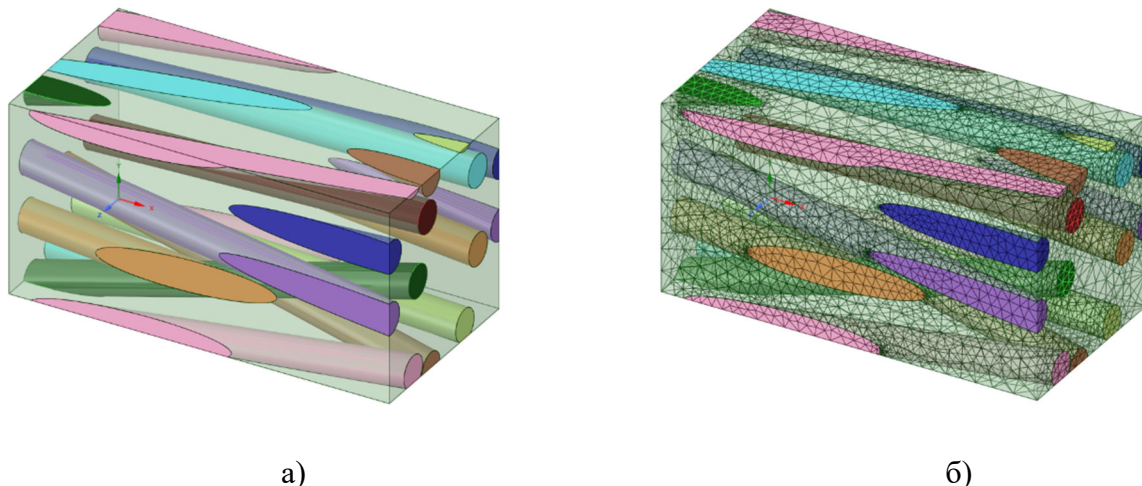


Fig. 1. Representative cell (a) and finite-element (b) model of nanomaterial with fibrous partially ordered inclusions

The results of the calculations have been presented in Table 1, the fibrous carbon inclusions of the same size and orthotropic properties of the material have been studied.

Table 1. Mechanical properties of nanocomposite with fibrous inclusions

| | | | | | | | | | | |
|----------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Volum e fractio n | 0.025 9 | 0.050 4 | 0.076 4 | 0.100 2 | 0.126 1 | 0.151 0 | 0.179 1 | 0.203 9 | 0.229 4 | 0.252 5 |
| E ₁ , MPa | 7815, 8 | 1478 8 | 2254 1 | 3098 5 | 3551 8 | 3918 7 | 4059 1 | 4047 1 | 5094 6 | 5833 0 |
| E ₂ , MPa | 4205, 3 | 4419, 4 | 4621 | 4780, 1 | 4934, 2 | 5106, 1 | 5378, 5 | 5568, 8 | 5753, 8 | 6301, 5 |
| E ₃ , MPa | 4090, 2 | 4397, 9 | 4589 | 4791, 8 | 5027, 8 | 5160, 1 | 5398, 8 | 5511, 3 | 5723, 5 | 6012, 1 |
| G ₁₂ ,M Pa | 1483, 7 | 1524, 9 | 1675 | 1636, 7 | 1870, 3 | 1815, 5 | 1915 | 1959 | 2200, 6 | 2385, 2 |
| G ₂₃ ,M Pa | 1447, 2 | 1490, 8 | 1544 | 1584, 5 | 1629, 8 | 1689, 3 | 1761, 7 | 1814, 7 | 1885, 8 | 1911, 8 |
| G ₃₁ ,M Pa | 1686, 4 | 1576, 8 | 1601 | 1654, 8 | 1794, 2 | 1838, 1 | 2246, 9 | 2477, 5 | 2340, 9 | 2113, 5 |
| v ₁₂ | 0,322 0 | 0,338 2 | 0,324 2 | 0,338 4 | 0,390 0 | 0,359 6 | 0,316 0 | 0,254 9 | 0,324 2 | 0,370 7 |
| v ₁₃ | 0,403 2 | 0,362 3 | 0,345 1 | 0,337 7 | 0,321 8 | 0,333 3 | 0,444 8 | 0,506 5 | 0,463 8 | 0,319 9 |
| v ₂₃ | 0,433 3 | 0,477 5 | 0,488 5 | 0,497 9 | 0,487 6 | 0,490 9 | 0,478 3 | 0,478 5 | 0,477 9 | 0,478 5 |
| Densit y | 1176 | 1192 | 1211 | 1224 | 1240 | 1256 | 1274 | 1290 | 1306 | 1321 |

It has been clarified the use of inclusions in the carbon nanofibers form demonstrates the increase in the strength characteristics of the material in the fibers direction. For the same inclusions volume fraction, fiber reinforcement was more than 10 times more effective than cylindrical or spherical reinforcement of the same material. In addition to significant hardening, which characterized by the module E₁, there was also hardening in other directions, close in level compared to other types of inclusions.

The results of research prove that the use of carbon nanofibers to create quality nanocomposite is appropriate and could be used to neutralize static electric charges that occur in oil storage and could lead to emergencies.

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