Lecture Notes in Networks and Systems 367

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Integrated Computer Technologies in Mechanical Engineering–2021

Synergetic Engineering

Springer

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Editors

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ISSN 2367-3370 ISSN 2367-3389 (electronic)
Lecture Notes in Networks and Systems
ISBN 978-3-030-94258-8 ISBN 978-3-030-94259-5 (eBook)
https://doi.org/10.1007/978-3-030-94259-5

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Nanocomposites Implementation for Oil Storage Systems Electrostatic Protection

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Abstract. Storage tanks are responsible engineering constructions designed to get, store, release and account the oil and petroleum products. Tanks elements in operational conditions sustain significant changes of temperature, high pressure, vibration, seismic loads, uneven subsidence, corrosion. The crucial issue 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 aim has been to increase the environmental safety of oil storage systems by effectively neutralizing static electricity using composites and nanocomposites with disordered and ordered systems of fibrous inclusions. Therefore, the innovative oil storage construction with improved characteristics has been proposed in the paper. It has been established the use of filler in the carbon fibers form demonstrates the growth of material strength characteristics in the fibers direction. Complete structured ordering of nanofibers further increases the strength properties in the main direction of the fibers location, but does not significantly reduce the strength characteristics in the other two directions. The results of research prove the use of carbon nanofibers to create the quality nanocomposite is appropriate and could be used to neutralize static electric charges that occur in oil storage and could lead to emergencies.

Keywords: Emergency · Environmental safety · Technogenic object · Oil reservoirs · Nanomaterial · Carbon fiber inclusions

1 Problem Statement

Storage tanks are responsible engineering constructions designed to get, store, release and account the oil and petroleum products. Tanks elements in operational conditions sustain significant changes of temperature, high pressure, vibration, seismic loads, uneven subsidence, corrosion. The crucial issue today is to ensure the reliability of operation and trouble-free operation of oil storage systems. One of the main causes of explosions

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M. Nechyporuk et al. (Eds.): ICTM 2021, LNNS 367, pp. 575–583, 2022.
https://doi.org/10.1007/978-3-030-94259-5_49

Table 2. Mechanical properties of nanocomposite with fibrous inclusions

Volume fraction	E_1, MPa	E_2, MPa	E_3, MPa	G_{12}, MPa	G_{23}, MPa	G_{31}, MPa	ν_{12}	ν_{13}	ν_{23}	Density
0,025	10935	4228,8	4228,8	1452,3	1444,9	1452,3	0,3454	0,3454	0,4649	1,176
0,05	18095	4429,3	4429,3	1506,5	1492,8	1506,5	0,341	0,341	0,490	1,192
0,075	25252	4589,9	4589,9	1562,8	1544,4	1562,8	0,3365	0,3365	0,5004	1,208
0,1	32404	4739,1	4739,1	1621,4	1600,6	1621,4	0,3328	0,3321	0,5057	1,224
0,125	39561	4883,3	4883,3	1682,3	1660,5	1682,3	0,3278	0,3278	0,5089	1,24
0,15	46719	5026,3	5026,3	1745,6	1724,6	1745,6	0,3255	0,3235	0,5110	1,256
0,175	53875	5169,8	5169,8	1811,5	1793	1811,5	0,3193	0,3193	0,512	1,272
0,2	61033	5316,2	5316,2	1880,3	1866,6	1880,3	0,3151	0,3150	0,513	1,288
0,225	68190	5466,5	5466,5	1952,2	1945,9	1952,2	0,3109	0,3109	0,5146	1,304
0,25	75347	5621,4	5621,4	2027,5	2030,7	2027,5	0,3068	0,3068	0,515	1,32

material in the direction of the fibers. Compared with partially ordered fibers, the complete structured ordering further increased the strength properties in the main direction of the fibers, the difference was more than 29%, but underestimated the strength characteristics in the other two directions by 6–12%. Thus, the carbon nanofibers using allows to create the high-quality nanocomposite with pronounced orthotropic properties [21, 22].

4 Outcomes

It has been established the use of filler in the carbon fibers form demonstrates the growth of material strength characteristics in the fibers direction. Complete structured ordering of nanofibers further increases the strength properties in the main direction of the fibers location, but does not significantly reduce the strength characteristics in the other two directions. The results of research prove the use of carbon nanofibers to create the quality nanocomposite is appropriate and could be used to neutralize static electric charges that occur in oil storage and could lead to emergencies. Thus, the innovative oil storage construction with improved characteristics has been proposed in the paper. In future it will be treated the different kinds of inclusions, their orientation in the representative cell to achieve the antistatic effect, increase the material durability and reliability.

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