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IMPACT PREDICTION OF TECHNOGENIC SEISMICITY ON THE STORAGE TANKS STABILITY

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Seismic loads are serious threat to the integrity of storage tanks with liquid hydrocarbons. Earthquakes could cause deformations and damage to tank structures, which leads to the leakage of hazardous substances, environmental pollution and significant economic losses. The abstract investigates the seismic loads impact on the structural integrity of storage tanks and analyzes methods to prevent and minimize negative consequences.

Modern approaches to increase the seismic resistance of tanks have been considered, such as floating membranes installation, internal partitions and damping systems application to reduce fluid vibrations.

A comprehensive method to increase the environmental safety of reservoir operation in conditions of increased seismicity has been proposed, which includes engineering solutions, regular monitoring, and improvement of the regulatory framework. The implementation of these measures will help to reduce the risks of emergency situations, ensure environmental protection, and increase the operation reliability of oil and gas storage facilities in seismically hazardous regions.

Reports of damage caused by past earthquakes show that liquid storage tanks exhibit complex dynamic behavior under seismic conditions. The occurrence of certain failures depends on factors such as the presence of anchors, slenderness factor, roof type, filling rate, etc. Experience shows that based on the height to diameter ratio, the dynamic behavior of the tank could be completely change. Typically, under seismic conditions, a thin tank behaves like a cantilever, with high stress concentrations at the base and a significant overturning moment due to the high center of mass. The most likely failures are uplift and buckling of the foot, rupture of the bottom-bottom shell joint, buckling of the bottom shell, failure of the inlet/outlet piping system, failure of anchors, buckling of the shell in the central part of the shell. Damage to the top and roof is not typical for tall tanks. In contrast, very squat tanks suffer more damage to the top due to fluctuations in the contents inside, including warping at the top of the body and roof, failure of the wall-roof junction, and failure of the column supporting the roof [1-3].

According to the research results, the free surface elevation in tanks of various shapes has been calculated under the action of seismic loads of different frequencies, magnitudes and at different distances from the earthquake epicenter. The free surface elevation in tanks has also been calculated using damping devices [4-5]. The forecast data for the change in the free surface elevation in tanks have been presented in Table 1.

Table 1 – Forecasting the impact of technogenic seismicity on the tanks stability

Seismic load frequency, Hz	Magnitude	Distance to the epicenter of the earthquake, m	Free surface elevation in the tank, m	Tank filling level, m	Tank type	Damping devices
2	3	300	0,32	1	prismatic	немає
2	3	300	0,17	1	prismatic	немає
2	6	300	0,25	1	cylindrical	немає
2	6	200	0,4	1	cylindrical	немає
4	8	800	0,3	2	cylindrical	немає
4	4	200	0,011	2	cylindrical	немає
2	4	500	0,05 (0,25)	1	cylindrical	membrane
2	6	200	0,2 (0,63)	1	cylindrical	membrane
2	6	200	0,03 (0,55)	1	cylindrical	ring partition at height 0,8 m, R_{hole}=0,5 m
2	5	500	0,2 (0,45)	1	cylindrical	ring partition at height 0,8 m, R_{hole}=0,5 m
2	3	500	0,02 (0,1)	1	cylindrical	ring partition at height 0,6 m, R_{hole}=0,5 m

Using damping devices, it is possible to reduce the fluctuations of the liquid in the tank by 20-30%, which will allow for the safe operation of liquid hydrocarbon tanks under seismic loads of up to 5 points, prevent spills and release of liquid hydrocarbons into the environment, and reduce the technogenic impact on the environment.

References

Sierikova O., Strelnikova E., Kriutchenko D. (2023). Membrane installation in storage tanks for seismic loads impact protection. Acta Periodica Technologica, (54). P. 209-222. https://doi.org/10.2298/APT2354209S

Sierikova O., Strelnikova O., Degtyarev K. (2022). Axial deformations determination of storage tanks for liquid substances. Proc. book of Tashkent Ist-International Congress on Modern Sciences (May 10-11, 2022). Tashkent, Uzbekistan. IKSAD Publications. P. 442-443.

Sierikova E., Strelnikova E., Gnitko V. (2022). The earthquake loads influence on storage reservoirs for environmentally hazardous liquids. Proc. book of International Ankara Congress on Scientific Research VI (April 1-3, 2022). Ankara, Turkey. ISPEC Publications. P. 1049-1050.

Sierikova E., Strelnikova E., Pisnia L. (2021). The Environmental Safety Level Increasing of Oil Storage Systems. Proc. of International Afghanistan Interdisciplinary Research Conference Taj Institute of Higher Education Mazar-i-Sharif, Afghanistan August 19. P. 286-288.

Degtyariov, K., Kriutchenko, D., Osypov, I., Sierikova, O., Strelnikova, E. (2024). Dampers Influence on Sloshing Mitigation in Fuel Tanks of Launch Vehicles and Reservoirs. In: Nechyporuk, M., Pavlikov, V., Krytskyi, D. (eds) Integrated Computer Technologies in Mechanical Engineering - 2023. ICTM 2023. 151 Lecture Notes in Networks and Systems, vol 1008. Springer, Cham. https://doi.org/10.1007/978-3-031-61415-6_36