

Gravity prospecting for cavities under the subsurface fuel storage tank

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Periodic inspection at the underground fuel storage site revealed that substratum under one of the fuel tanks is eroded. Macroscopic cavities were observed in the hole for the mud box. Fuel tank is circular with diameter of 12 m and height of 10 m. The tank is made from sheet steel, behind the walls and at the bottom is reinforced concrete. The tank is covered up with soil, substratum under the bottom is formed by sandy gravels. The aim of geophysical survey was to reveal the extent of cavities under the bottom of the tank. The usage of ground penetrating radar or another geoelectrical method was not possible because of steel on the walls and reinforced bars at the bottom of the tank. We decided for precise gravity measurements inside the storage tank. The floor of the tank was evenly covered by 90 gravity stations. Stations were leveled and gravity was measured by gravity meter with resolution of 0.001 mGal. From repeated measurements taken at gravity stations in different times the mean square error of 0.003 mGal was calculated. The value of error of gravity measurements was the principal parameter for the choice of the optimal method for residual drift removing. Gravity data were processed and relative Bouguer anomalies were calculated. Contour lines in the map of Bouguer anomalies are circular with maximum close to the center because measured gravity is strongly influenced by the distance from the walls of the tank. Bouguer anomalies were corrected for the gravity effect of the material behind the walls of the tank and then separated to the regional and residual parts. The range of residuals is 0.035 mGal and areas of negative anomalies clearly indicate the eroded substratum under the bottom of the tank. The modeling of residual anomalies enabled to distinguish two differently eroded areas: one area with shallow cavities to the depth of 1 m, second area deeply eroded to the depths of several meters. The sheet steel from the floor of the tank was cut off and in the places indicated by gravity survey were drilled boreholes. Results of drilling confirmed interpretation of gravity data and cavities under the bottom of the storage tank were finally filled.