DETERMINATION OF THE PARAMETERS OF THE REQUIRED FRP REINFORCEMENT OF METALLIC SHELLS OF CYLINDRICAL TANKS

Dziuba S.V., Ph.D., Associate Prof.; Korshak O.M., Ph.D., Associate Prof.;
Mikhailov O.O., applicant for Ph.D.
(the department of metal, wood and plastic structures)

The required thickness t_f of the external transverse directed FRP reinforcement of the metal walls of cylindrical tanks be able to determined using the coefficient $k_{f(t)}$:

$$t_f = k_{f(t)} \cdot t_s ,$$

where t_s – the thickness of the steel shell of the cylindrical tank.

The value of this coefficient in practical calculations can be obtained as

$$k_{f(t)} = t_f \Big/ t_s = A_3' - A_2 \Big/ A_1 ,$$

where $A_1 = m\left[(1-\mu/2) f_{yd} - (\mu/2)\Delta\sigma_{s+} + \Delta\sigma_T\right]$,

$A_2 = (1-\mu/2) f_{yd} - (1+\mu/2)\Delta\sigma_{s+} + \Delta\sigma_T$, $A_3' = 1/m$ — auxiliary values.

The value of the coefficient of the required external transverse FRP reinforcement depends on the parameters of design yield strength of steel f_{yd} (or the limiting stress value permissible from the conditions of fatigue of the material of the shell joints) and the ratio of the elastic modules of steel and FRP $m = E_f / E_s$. The value of the Poisson's module of the steel component of the tank wall μ is used. The influence of differences in the coefficients of thermal deformation of the materials is estimated by the corresponding stresses

$$\Delta\sigma_T = \Delta\alpha \cdot \Delta T \cdot E_s ,$$

where $\Delta\alpha = \alpha_s - \alpha_f$ – the difference between the coefficients of linear thermal deformation of steel and the layer of FRP; ΔT – the most critical temperature changes; E_s – the module of elasticity of steel.

The excess of stresses over its limiting value (yield strength of steel or maximum stresses determined by the fatigue of the material of the joints) in a metal shell in the absence of external reinforcement are defined as

$$\Delta\sigma_{s+} = \frac{N_{\Delta P(x)}}{t_s} - f_{yd} .$$