Gdansk,…………….

Abstract

Cavitation erosion is a mechanism of material degradation as a result of cavitation, which occurs in many branches of industry. The scientific aim of the dissertation was to analyze the effect of cavitation loads (fluid flow velocity) on the cavitation erosion process of AISI 304 and AISI 321, S235JR and S355J2 steel, in the delivery condition and after heat treatment. The work broadens the scope of knowledge concerning cavitation erosion resistance of austenitic and ferritic-pearlitic steels.

The work consists of two parts (*12 chapters*). The first part (*8 chapters*) presents a literature review presenting the current state of knowledge regarding the phenomenon of cavitation erosion of single-phase (austenitic) steels and two-phase steels, focusing on steels in which one of the phases was the ferritic phase. An overview of the correlation between the cavitation resistance and the mechanical and surface properties of steel is also included. The second part (*4 chapters*) presents the thesis, objectives, scope of the work and presents the description of the measuring stand and the tested materials, the research methodology, as well as the results of the research, discussion and final conclusions.

The scope of the research included determining the impact of cavitation loads on the process of cavitation erosion. Cavitation loads were defined by the fluid flow velocity, which was dependent on the set pressure in front of the cavitation chamber (p_1). This approach was assumed based on research conducted by many researchers.

The tests were carried out in a cavitation tunnel at four fluid flow velocities: 2.30 m/s, 2.49 m/s, 2.67 m/s and 2.83 m/s. With the increasing fluid flow velocity, a linear increase in the erosion rate and mass losses was noted. It has been proven that mass loss and erosion rate are closely related to material properties. Hardness, percentage elongation and yield point of the tested steels had a significant impact on the cavitation erosion resistance of the tested steels. A logarithmic relationship was obtained between the relative change in hardness (ΔH) and maximum value of the parameter Ra of the eroded surface. Thus, the increase in the roughness of the eroded surface is closely related to mass losses,

and thus to cavitation erosion resistance. The high ability of austenitic steels to hardening as a result of cyclic implosion of cavitation bubbles has been demonstrated.

Measurements of the surface roughness (*Ra parameter*) as a function of the fluid flow velocity revealed an increase in the maximum value of the Ra parameter (Ra_{max}) to the flow velocity of 2.67 m/s, and then a decrease in this value with increasing fluid flow velocity, regardless of the tested material. The area of increased roughness in relation to the initial value increased with the test time and flow velocity. The asymmetry of the erosion area was also observed based on the measurements of the roughness of the eroded surface and the expansion of the erosion area with the increasing fluid flow velocity. The obtained roughness measurements made it possible to develop a correlation allowing for the estimation of mass losses. The results obtained using the proposed model are characterized by a high fit with experimental data, and the relative errors are in the range of up to 30%.

In addition, the correlations between mechanical properties and cavitation erosion resistance presented in the first part of dissertation were validated. It has been shown that the existing correlations are of limited applicability.