Koszalin, 29.03.2019

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ABSTRACT

Hydraulic conditions and self-excited pulsating head impact on the characteristics of water jet produced

Undertaking this research topic results from the need to increase the efficiency of a treatment with the usage of high-pressure water jets. The increase in water jet efficiency is usually achieved by generating ever higher water pressure. However, a radical development of innovative methods of such treatment is possible thanks to the usage of a water jet with a periodically variable structure and dynamic properties. Due to the possibility of such development of technological applications of high-pressure water jet, the implementation of this topic was undertaken.

The aim of the dissertation is to determine the impact of geometric parameters of the self-excited pulsing head and hydrodynamic working conditions on the functioning of such head and the dynamic characteristics of the water jet, generated in it, as well as its technological suitability for material eroding.

The aim of the dissertation was pursued by conducting both computer simulation tests and experimental tests, using a self-excited pulsing head made on the basis of the results of computer research. During the experimental tests, the impact of geometric parameters and hydrodynamic conditions on the character and distribution of hydrodynamic impulses of the water jet generated in the developed construction solutions of the self-excited pulsing head was determined.

The following working hypotheses were adopted to achieve the aim:

1. Geometric **parameters of the self-excited pulsing head**, such as: the diameter and height of the vortex chamber, its angle of attack and diameters of the side openings, in particular, the diameter and height of the inlet nozzle, with the diameter and height of the outlet nozzle; **as well as hydraulic working conditions** in the form of a pressure - along with the nozzle diameter – determining the flow rate of water flowing through such head, **decide about its functioning** that manifests in the form of dynamic

pressure distributions and diversified flow forms in the vortex chamber as well as the flow velocity of the jet flowing out from such a head, which **determine the properties of the generated water jet and its behaviors.**

2. **A water jet generated in favorable conditions of functioning of such self-excited pulsing head** with the optimized geometric parameters, taking into account the variability of hydrodynamic operating conditions of such a head, **significantly affects the variability of its internal structure and its dynamic properties** (such as the value of the jet contact force, distribution of its momentary pressures and the frequency of occurrence of these changes) **as well as the increase in the technological efficiency of material eroding**.

The main purpose of the dissertation is the selection of geometric parameters of the self-excited pulsing head, such as: diameter and height of the vortex chamber, its angle of attack and diameters of the inlet side openings, in particular, the diameter and height of the inlet nozzle and outlet nozzle. An equally important purpose is to determine the hydrodynamic operating conditions of such a self-excited head in the form of pressure, which together with the diameter of the nozzle, determine the water flow through this head. All these parameters determine its functioning, manifesting in the form of dynamic pressure distributions and diversified flow forms in the vortex chamber as well as the flow velocity of the jet from such head, thus such quantities that have a significant impact on the properties of the generated water jet and its behaviors.

Favorable operating conditions of such self-excited pulsing head, with the optimized geometric parameters and taking into account the variability of hydrodynamic operating conditions of such head, significantly affect the periodic variability of the internal structure of the generated water jet and its dynamic properties (such as the pressure of the water jet and the frequency of its changes) and they also increase the technological efficiency of material eroding.