Abstract

The process of scale deposition is the cause of progressive degradation of hydraulic channels and other infrastructure elements in contact with hard water. Currently used flow meters are particularly susceptible to damage in such conditions. Developing a new method of flow measurement that takes into account the presence of scale deposits in the pipeline is a task undertaken by the author. The process of deposit formation progressing over time is the cause of unfavorable changes in operating parameters caused by a decrease in the effective cross-section (diameter) of the hydraulic system and a loss of operational reliability of the measuring system. This work presents the concept of a new flowmeter solution ¬ taking into account the presence of scale in the pipeline - the main element of which is a ring flow sensor (PCP) - using a method belonging to the group of thermal mass measurements. The principle of operation of the device is based on the dependence of the value of the selected parameter, the time constant of the temperature sensor, the water flow stream and the thickness of the rock deposit. The proposed solution is characterized by a simple design and measurement of only one value, in this case the course of temperature changes over time. On this basis, the thickness of the scale deposit layer is determined, and then the flow of water is determined. The conceptual assumptions were verified using prepared computational models and then performed experimental measurements. The influence of the PCP installation location on potential measurement errors was also analyzed. Tables of the dependence of the time constant on the thickness of the rock sediment and the flow stream were developed. Parametric calculations were performed for the numerical model and the physical modeling scheme. The obtained results made it possible to propose a PCP design solution. Initial conditions for optimizing the proposed solution were discussed. The obtained results and conclusions from the conducted research may constitute the basis for further development work and theoretical analyzes on the presented issue.