Objective of the proposal. The main scientific objective of the proposal is to investigate, examine and understand the wear process of a metal – elastic polymer sliding couple lubricated by water containing solid debris particles of mineral origin.

Planned research. The special purpose, recently designed and built, already present in the laboratory, test stands for investigating water lubricated sliding bearings will be used. The test stand allow for examining the wear process of sliding couples while simultaneously precisely recording resistance of motion and temperatures.

The main aim of the work is to investigate and understand the nature of the wear process of a metal – elastic polymer sliding couple. Until the present day, the impact of progressive solid particles degradation process and its influence on steel journal wear process during their flow with lubricating liquid through the sliding couple has not been examined. In all the known research completed in the past, the lubricating agent was circulating in a close loop system or the tests were carried out in a tank containing debris. The planned research will be performed in the conditions of lubricating agent circulation, in which the solid particles are progressively degraded, as well as in the conditions of lubrication with a single (or controlled number of) passage of the lubricating agent – so that the impact of the particle decomposition process on the sliding couple's wear process may be investigated. The next important research problem is particles concertation. It was proven in previous research that high concentration of particles can block stiff sliding couple. The influence of the particles concentration on sliding couple will be studied. Size of the solid particles in relation to a bearing diameter has strong influence on wear. How to scale a problem? It is a one of the main problems to be solved.

The wide spectrum of diverse and interconnected thermal, flow and mechanical phenomena presents immense challenges in conducting theoretical bearing research. The authors are no aware of any computational models of bearings, which allow for simultaneously taking into account all the mentioned phenomena accompanying the work of a bearing. Even in case of models of individual effects, such as, e.g., turbulence or cavitation, a detailed experiment-based verification is necessary.

Genesis of proposed scientific work. Water lubrication of metal - polymer sliding couples is a solution of an immense potential. What is significant, there is no risk of contaminating the natural environment with petroleum-based products. However, as it turns out, there also remain significant problems to be solved connected with, among others, disadvantages inherent to plastics, for instance, their poor thermal conductivity, substantial thermal expansion, water absorption resulting in unstable shape or stick-slip phenomena. Another, separate problem is the low viscosity of the lubricating agent – water, which impacts hydrodynamic processes occurring between journal and bush. As it turns out, the key issue for the durability of the sliding couple may be pollution of the water with solid debris particles – usually of mineral, corrosion or wear origin. Aside from its scientific value, the proposed works have also a practical aspect. As an example, one may mention the Fukushima nuclear plant disaster in Japan, which was caused by malfunctioning pump supply-system and cooling-system pumps. Sliding bearings of the main pumps were being lubricated by water which was highly contaminated with debris resulting from a calamitous tsunami and became drastically worn down in a matter of about 90 minutes.

Significance of the research proposal

The project is of both scientific and utilitarian significance. Its completion will allow for obtaining new knowledge on the processes of friction and wear. Practical knowledge regarding selection of sliding couples, shaping their geometry, utilizing the latest CFD and FEM software to create models of friction nodes will allow for increasing the ecological safety through "green" bearings to be used in water pumps, hydro power or shipbuilding. Key directions of development include, among others, "green tribology" concentrating on friction and wear of sliding couples from which substances harmful to the natural environment have been eliminated – especially petroleum-based oils.