Tribology is a very extensive field of science covering, among others, such subjects as: lubricating agents, rolling bearing, sliding bearing, nanoscale friction phenomena, external layer, lubrication additives, coatings, biotribology and numerous others. This field also includes issues which the proposed project is concerned with, such as, application of an environmentally friendly fluid, i.e. water, for lubricating and cooling of active friction pairs. Nearly 1200 scientific articles are published in the five leading tribology journals every year. In recent years, these publications have also included works concerning water lubrication problems.

The goal of the submitted research project is to investigate the phenomena which accompany operation in demanding, unfavorable conditions of such differing friction pairs as: metal – polymer , and metal – metal. The employed lubricating agent – water, is becoming increasing popular as it is a widely available, environmentally friendly and possesses exceptional properties. In the understanding of the authors, demanding working conditions are characterized by:

- Lubrication occurring under conditions of insufficient cooling resulting from limited or even absent flow of the cooling agent through the friction pair
- Lubrication conducted with a non-optimal agent of low viscosity, weak lubricating ability, containing pollutants in the form of solid particles.

As part of the research project, we plan to complete theoretical and experimental studies; the analyzed friction pair consisting of rotating journal and fixed bush (i.e. a radial sliding bearing).

The theoretical study of heat exchange processes between the co-working sliding elements will be conducted employing advanced software which utilizes the finite element method and computational fluid dynamics.

The experimental research will be conducted using advanced, especially designed and constructed test rig.

The test rig will allow for investigating the progression of wear process by forcing the polluted lubricating agent through the friction couple in different ways.

The test stand was designed in such a way, as to eliminate one of the main problems common in this type of experiments, i.e. the particles depositing in the lubricating agent distribution system and the stemming from it problem of lubricating with liquid of pollution levels which differ in time scale. It is planned to test approximately twenty diverse friction pairs of varied properties:

- soft stainless steel - polymers, synthetic rubber, composites,
- hard stainless steel – polymers, synthetic rubber, composites, sintered bronze,
- bronze – polymers, synthetic rubber, composites.

The test results should allow for drawing conclusions as to the influence of sliding pair and its geometry on the wear process. Investigating the wear process may be very time consuming. Despite the anticipated test rig operating time with minimalized periods of stoppage, the testing of a single sliding pair may take as long as three weeks. This is one of the reasons behind the extensive time period of project duration.

The experimental research aimed at identifying problems of friction pairs working under conditions of limited lubricating agent flow will be conducted on a test rig driven by a 220kW motor. The high torque motor will allow for conducting trials in extreme conditions accompanied by sudden temperature increases of the sliding combination, and abrupt surges in the resistance of motion levels which may stem from the seizing processes. The installed measuring equipment will allow for recording the resistance of motion as a function of time, temperature in selected locations, the shaft rotational speed and possibly shaft axial trajectory or hydrodynamic pressure in the lubrication interspace.

It should be added, that the equipment at the disposal of the applicants is quite unique on a global scale. The entirely new high power test rig is currently undergoing initial testing.