The Earth's surface is covered with water in about 75%. Therefore it would seem that the scenario in which humanity is struggling with a shortage of drinking and sanitary water is only possible in catastrophic films. However, nothing could be more wrong, as approximately 97% of the world's water resources are undrinkable salt water. Every year more and more countries worldwide, including Poland, have to grapple with the growing problem of limited access to drinking water. In addition, various activities are undertaken worldwide, such as regulating the limits of greenhouse gas emissions, the purpose of which is broadly understood as "environmental protection". Therefore, cheap and environmentally friendly methods of water desalination are sought. One such method is the so-called passive solar desalination, carried out in devices called passive solar still.

The principle of operation of passive solar water distillers can be compared to the natural hydrological cycle of the Earth, the basis of which is the heating of water from solar radiation. The water then evaporates, condenses in the upper atmosphere and returns to Earth as precipitation. Similar processes take place in solar water distillers so that these devices can desalinate water using only solar energy. However, the performance, i.e. the volume of condensate obtained per time unit, of passive solar water distillers is relatively low. Various methods are being sought to improve it. One of the methods of improving the efficiency of solar water distillers is the use of phase-change materials (PCM).

Phase change materials are up-and-coming materials for heat storage. They undergo reversible phase changes, for example, solid-liquid transformations. As a result of phase transformations, large amounts of heat are absorbed or released per unit mass of the material. An additional advantage is that these transformations are isothermal (or close to isothermal). Therefore, PCMs can have a wide range of applications - from energy, construction and the food industry to medicine. However, the factor that hinders the use of PCM materials, especially organic ones, on a large scale is their low thermal conductivity, which makes the phase change too slow and the process ineffective.

Additionally, when a solid-liquid transformation is used, it is necessary to place the PCM in the tank to prevent leakage of the resulting liquid. However, instead of using traditional tanks, such as metals or plastics, more and more attention is paid to composite materials made of shape-stabilised phase change materials. In this case, the phase change material is integrated into the pores of the porous matrix. Thanks to capillary forces and surface tension, no leakage of the PCM occurs, even if the material is in a liquid state.

Aerogels are porous materials that are of increasing interest. Thanks to their unique properties, such as low density, high specific surface area, and high sorption capacity, these materials are ideal candidates for stabilising phase change materials. Aerogels can be made from various precursors, both organic and inorganic, but aerogels based on organically modified silica compounds (ORMOSIL) deserve special attention. The properties of such an aerogel can be fully controlled and adjusted as needed.

The project aims to synthesise and then study the properties of phase change materials stabilised with organosilica aerogels and study the impact of these materials on the performance of a solar water distiller. Additionally, both the PCMs and the aerogel structure itself will be enriched with various thermal conductivity enhancers. The synthesised materials will be tested for structural, chemical and thermal properties. Particular emphasis will be placed on the lack of leakage of the PCM while maximising the aerogel's sorption capacity and improving the thermal conductivity coefficient of composite materials while maintaining the highest possible latent heat of fusion. Moreover, the influence of these materials on the operating parameters of a solar water distiller will be investigated, and a mathematical model describing the processes taking place in the device will be built.

The conducted research will allow for selecting an appropriate aerogel structure to stabilise the phase change material and the selection of a thermal conductivity enhancer, ensuring the best improvement of the thermal conductivity coefficient. The synthesised aerogel / PCM / dopant materials are expected to improve the performance of the solar water distiller.