C.1. DESCRIPTION for the GENERAL PUBLIC

Water presence is crucial for life of mankind, animals and plants. Water is one of the most important substances on the Globe. Unfortunately many regions over the world feel lack of potable water and this problem will be increasing during coming years. During past few years Poland also had experienced a problem of lack of water. On the other hand, industry consumes huge amounts of water which needs to be treated (softened) to avoid hard scale formation in various installations, especially those working at higher temperatures. Chemical water treatment involves not only high costs but also contamination of the natural environment. Therefore so called non-chemical methods of water treatment are of continuous interest of researches. Among the methods application of magnetic field is widely investigated for several decades and many companies offer so called magnetizers for applications both in industry and households. Effectiveness of such devices is problematic at least and so far there is no complete scientific explanation of the observed effects of magnetic field observed both in laboratory conditions and some industrial processes. Nevertheless scientific explanation of this phenomenon is needed both for fundamental knowledge and practical purposes. In the literature are mostly published researches on the static magnetic field on aqueous solutions and the results are often controversial. Moreover, reproducibility of the obtained results is low, especially as for the industrial investigations. Basing on the literature results it can be stated that external magnetic field may influence hydrogen bonding structure of water and thus influence the boiling temperature, rate of water evaporation and enthalpy of evaporation, surface tension and viscosity of water, electric conductivity, and possibly pH. Furthermore, these changes should also affect kinetics of calcium carbonate precipitation from aqueous solution and its crystallographic structure, as well influence its properties in aspect of the precipitate adhesion to the heating devices. The latest investigations have shown that magnetic effect on the calcium carbonate precipitation can be explained on the basis of non-classical mechanism of nucleation of calcium carbonate considering formation of clusters of pre-nuclides and proton dimers. However, not the absolute value of the magnetic field strength but its gradient affects more formation of the clusters and dimers, which last for a period of time. This also explains presence of the magnetic field memory effect. However more experiments are needed to verify this theory.

In the fundamental studies on magnetic field effect it is very important purity of the water sample used, as well as the kind of substances of which the setup being in contact with the field had been made. This is because often the observed effects are in fact due to impurities originating from some parts of the device and are not due to the magnetic field itself. Therefore, to eliminate such artifacts the proposed experiments will be conducted in vessels and tubes made of Teflon, which is the most inert material, and water used for the experiment will be extremely purified, i.e. deionized in Milipore-Q system and then distilled in all-quartz still.

The objective of the proposed studies within this Project would be conductance of systematic fundamental studies using well defined and maximally pure systems in order to verify so far known results dealing with influence of magnetic field on changes of water properties and taking into account the latest theories of this effect. It is believed that the obtained results would shed new light to better understand the mechanism of the field action both on the polar liquids and adhesion of calcium carbonate to heating elements.

In the first step of the investigations effects of static magnetic field acting in kinetic conditions on the macroscopic properties of water will be determined, i.e. boiling temperature, kinetics of water evaporation and its enthalpy, viscosity, surface tension, electric conductivity, pH, which properties obviously results from the changes on molecular level.

The second step would involve determination of magnetic field effect on the kinetics of calcium carbonate precipitation from aqueous solutions and its crystallographic structure. The structure, size and crystallographic forms of the precipitated calcium carbonate crystals would be determined with the help of infrared spectroscopy (FTIR) or Raman spectroscopy, x-ray diffraction (XRD) and scanning electron microscopy (SEM), as well laser dynamic light scattering (ZetaSizerNano).