DESCRIPTION FOR THE GENERAL PUBLIC

Processes of mechanical mixing of liquids are widely applied in several branches of the process industry. The aim of mechanical mixing is achievement of a defined level of homogeneity of the manufactured product and is therefore a crucial factor determining its final quality. In practice, many products of every-day use, including food, cosmetics, pharmaceuticals or chemicals are characterised by complex rheological (flowing) characteristics, which adversely influence effective mixing of those products. Such products belong to the class on non-Newtonian fluids.

One of the main reasons of insufficient level of homogeneity in the whole volume of non-Newtonian liquids is their high viscosity. That rheological property determines resistance of the liquid to forces making it flow. In addition, in the case of complex rheology liquids their viscosity varies depending on the externally applied force, e.g. by a stirrer. The variable viscosity causes during mechanical mixing that a zone of intensive mixing is formed close to the stirrer. In that zone called a cavern, the liquid flows with high velocity, whereas outside it the liquid hardly flows and is poorly blended. The zones of poor mixing prevent achieving the desired homogeneity of the stirred liquid and concurrently worsen the quality of final products. Therefore, it is vital to ensure such conditions of mixer operation that the poorly mixed zones are minimal.

The state of research on formation of the zones of intensive mixing of stirred liquids indicates that the current description is based mainly on simple analyses of experimental material. The description is partly supported by results of numerical simulations where incomplete rheological characteristics were used. The literature papers present results which enable approximate calculation of the cavern sizes but do not explain mechanisms of their formation. In the presented project we undertake with the help of laws of physics to study and explain the mechanism of creation of the intensive and poor mixing zones in mechanical mixers. The assumed research aims at devising effective methods of designing and exploiting mixers for complex rheology liquids. It is expected the measures will prevent formation of poorly mixed zones. Application of the methods should ensure reaching the required homogeneity of the final product in its whole volume, which finally results in its high quality.

Within the research planned in the project, wide experimental and theoretical investigations will be executed. The research will also allow to verify two novel research hypotheses referring to the formation of the intensive mixing zones. The applied methodology of experimental and numerical investigations was selected according to the best standards published in the world literature. Such the innovative methods of research will enhance the analysis of formation of the intensive mixed zones and will significantly widen our knowledge on the mechanical mixing of complex rheology liquids.