Popular science abstract

The particulate substances, especially nanoparticles, have an increasing meaning. Their wide application can be encountered in such branches of industry like pharmacy (enhanced drug delivery), cosmetics, in medical imaging and diagnostic, pesticides as well as in catalysis. That is why there is much ongoing research to develop an economical production process for obtaining very small particles (especially nanoparticles) with a desired and reproducible properties. Moreover, there is much pressure to make the process easy to adapt to industrial conditions. From this point of view precipitation is in the most interesting because of its simplicity, inexpensiveness and efficiency.

Within this project the investigations regarding precipitation in a special multifunctional reactors will be conducted. Such devices are of compact design and simple operation: inside the tube immobile elements are placed which assure good mixing of substances. Thus, the reaction can be run in a quick and convenient way. Moreover, because precipitation is often a fast process, the mixing process as well as residence time will affect the end product properties. But because no one knows what are the limits of application of such reactors, they should be determined. For this purpose laboratory experiments of three salts will be conducted. One of them has a relatively high value of solubility (calcium sulfate), the remaining two (barium sulfate and calcium oxalate) – over 10000 times lower. The latter two salts represents two groups of compounds: inorganic and organic. The first one is very well described in the literature. On the other hand, the second group (organic) is more challenging. Moreover, calcium oxalate is a compound that can be found e.g. in kidney stones.

In the planned investigations the relations between flow conditions in multifunctional reactor, precipitation kinetics and product properties will be determined. The research will also be conducted by means of computer calculations. Data collected during laboratory experiments will be used as a reference values. The properly prepared model verified by laboratory measurements will, in the future, allow to predict the course of precipitation reaction and to determine basic product properties without the necessity of conducting experiments.

The proposed project posses high cognitive importance because the planned range of research is insufficiently described in the literature. There is also a high demand to develop an easy and effective way of production particulate substances on an industrial scale. The available data concerns mostly the basic characteristics of flow, the influence of different parameters on mixing intensity, residence time distribution, pressure drop, micro- and meso- mixing zones determination etc.

The realization of the above mentioned tasks will allow to describe mathematically the discussed issue and find an answer to questions regarding the interactions between induction time of precipitation process and residence time in static mixers at various flow conditions. Moreover, it will let to determine the range of practical application of this type of reactors in process of crystallization with chemical reaction.