**Influence of fluid dynamic conditions on the course of precipitation reactions in a static mixer**

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**Highlights**

* Three different salts were precipitated.
* Kenics static mixer was used as a multifunctional reactor.
* Influence of fluid dynamics on reaction kinetics and obtained crystals was investigated.

**1. Introduction**

In recent years there is a growing need to produce systems of small particle diameters with the desired and reproducible qualities and characteristics in an economical and easily scalable way. This is especially visible in the case of nanoparticles applications: the great desire is for pharmaceutics, cosmetics, medicinal imaging and diagnostics. Taking all that into account the natural choice would be precipitation. This reaction is simple, inexpensive and efficient thus the economy is favorable [1]. For the precipitation reaction the residence time is not of crucial importance, as the reaction is very fast. More significant will be high mixing efficiency and uniform unit power input in order to avoid an uncontrolled supersaturation regions [2]. For those reasons the precipitation could be successfully conducted in static mixers [3, 4]. In comparison to tank reactors they are much easier scalable and takes a lot less space, but their applicability is limited.

**2. Methods**

In this study precipitation of three compounds were considered: CaSO4, CaC2O­4 and BaSO4. The production of those salts was conducted according to the equations:

Na2SO4 + CaCl2 + 2H20 → CaSO4⋅2H2O↓ + 2NaCl

C2O4H2 + CaCl2 + H2O → CaC2O4⋅H2O↓ + 2HCl

Na2SO4 + BaCl2 → BaSO4↓ + 2NaCl

The substrates were aqueous solutions of Na2SO4, CaCl2, H2C2O4 and BaCl2 respectively, introduced in stoichiometric proportions. Investigated salts are characterized by different solubility product and thus the relative supersaturation is maintained at the same level in order to investigate the influence of fluid dynamics on reaction kinetics and product characteristics.

The selected multifunctional reactor was Kenics static mixer with six inserts. Its total length was equal to 0.165 m and inner diameter was 0.0136 m. Change of fluid dynamic conditions was assured by investigating Reynolds numbers in the range of 500 to 2000.

The laboratory setup is presented in figure 1. It consisted of two tanks (1) in which solutions of two reagents were prepared and stored. Solutions were pumped to the reactor (3) using peristaltic pumps (2). The obtained suspension was collected in storage tank.

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**Figure 1.** Experimental setup.

**3. Results and discussion**

The precipitation of three different insoluble salts was performed assuring the same fluid dynamic conditions in form of range selected range of Reynolds number and similar level of relative supersaturation. Each of investigated compounds was characterized by different solubility and product characteristics. The results show that there is a noticeable influence of fluid dynamic conditions on precipitation kinetics and product characteristics.

**4. Conclusions**

Different characteristics in terms of solubility of precipitated compounds results in very different kinetics of the reaction. The influence of fluid dynamic conditions on product characteristics is also undeniable.

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