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PROCESS AND AGITATOR DESIGN FOR INDUSTRIAL CRYSTALLIZATION PROCESSES

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ABSTRACT

Crystallization is one of the oldest and very important unit operations, widely used in the chemical industry as well as in other industries such as the minerals processing industry. Its main purpose is the purification, separation and production process itself.

Products generated by crystallization process steps are manifold. These include valuable products such as pharmaceuticals, organic fine chemicals and proteins. Commodities are polymers and one of its precursors terephthalic acid. Some of the many other examples are sucrose, sodium chloride, aluminium hydroxide and fertilizer chemicals such as potassium chloride or ammonium sulfate. Products nickel sulfate, cobalt sulfate and lithium carbonate are gaining in importance as they are critical raw materials for products for the lithium-ion battery market. Here product quality as large, well-formed crystals and high purity are important factors.

Crystallization is governed by thermodynamics, mass and heat transfer, reaction kinetics and fluid flow. This leads to the conclusion that the mixing and blending process is a decisive factor for successful suspension in crystallization. Besides the process requirements, the equipment size and power consumption of the crystallizer agitators is a very important factor when it comes to the economic aspects, as industrial crystallizers in large part are operated continuously. Therefore the efficiency of the impeller system is of utmost importance. This paper presents the EKATO Torusjet, an improved impeller type applied in draft tube agitated systems typically used in continuous crystallization processes, achieving substantial higher efficiencies compared to standard solutions. This means that at a given motor power it achieves higher pumping rates, a better degree of slurry homogeneity and an improved surface renewal, which finally leads to a more uniform crystal growth. This was achieved by engineering its blade geometry using simulation tools also resulting in decreased local and overall shears rates, minimizing crystal breakage and reducing abrasion issues.

Crystallization processes occur in multiphase and multicomponent systems, i.e. solids are produced that have to be homogeneously suspended. These have a significant impact on the flow behavior or performance of the crystallizer. Test results and a model to assess commercial scale power requirements considering the solids are presented in this paper as well as implemented designs.

Key words: Crystallization, Agitator, Draft tube, Torusjet, Nickel sulfate, Cobalt sulfate, Lithium carbonate