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SPECIAL SEMINAR

Friday, August 30, 2019
Seminar Presentation: 1:30pm – 2:30pm
SME room 248

"Application of Taylor Vortex Flow to Crystallization Technology"

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Abstract: The crystallization is a popular unit operation for the separation/purification and particle/powder productions in wide areas of pharmaceutical, fine chemical, food, petrochemical industries due to its own unique features of self-assembly and molecular recognition involved in crystal nucleation and growth [1]. Since Taylor vorte flow was first applied to the reaction crystallization of calcium carbonate in 1994 in our lab, a crystallization technology using the Taylor vortex flow has intensively been studied for separation of chiral isomers, purification of the bio-products, control of polymorphism, phase transformation and crystal size distribution of API, synthesis of nano-particles etc over 25 years. The Taylor vortex flow is a periodic toroidal fluid motion occurring at the gap between two co-axial cylinders when rotating the inner cylinder above a critical speed. Due to its unique fluid motion, Taylor vortex flow brought about many bebeficial effects on the polymophic nucleation, phase transformation, agglomeration, crystal size distribution etc. As such, the stable crystals of sulfamerazine (SMZ) were directed nucleated in the Taylor vortex flow due to the molecular alignment effect, whereas the metastable crystals were first formed, and then transforemd to stable crystals in the turbulent eddy flow over seveal weeks. Also, the phase transformation of crystals in the Taylor vortex flow was several times faster than that in the turbulent eddy flow due to the higher mass transfer rate. Thus, the crystallization process using the Taylor vortex flow was 10~20 times more productive than that using the turbulent eddy flow. Non-isothermal Taylor vortex flow was also advantageous to control of the crystal size distribution. Due to internal loop of temperature cycling in the non-isothermal Taylor vortex flow, the dissolution and recrystallization of crystals occurred automatically to result in the narrow crystal size distribution. In addition, it was highly effective for crystal agglomeration, and so produced a spherical agglomerates of $(Ni/Mn/Co)(OH)_2$, of which the tap density was as high as over 2.2 g/cm^3. According to our studies, it was demonstrated that the crystallization technology using Taylor vortex flow wa highly effective and applicable to various materials of industires.

[1] Davey, R. and Garside, J. *From molecules to crystallizer*, OCP, 2000

Biosketch: Woo-Sik Kim is a professor at the Department of Chemical Engineering and a director of Functional Crystallization Center in Kyung Hee University. He received a B.S. from Seoul National University in Korea (1982), an M.S from KAIST in Korea (1984) and a Ph.D. from Pennsylvania State University in U.S.A. (1992), and joined at Kyung University in 1994. His research area is the crystallization for separation, purification and material synthesis and processing. Especially, he emphasizes the development of new crystallization technology using periodic fluid motions such as Taylor vortex flow and Batchelor flow. Currently, he has published over 225 scholarly research articles and 66 patents. Professor Kim is also the recipient of a number of honors and awards including Kyung Hee Fellow, Chair Professor of National Central University in Taiwan, Prime Minister Award of Korea, Scientists of Month Award of Korea, Award of Best National Research of Korea, Chang-Kyun Choi Award of Transport Phenomena of KIChE, and Magnolia Award, Excellency of Academic Achievement and Best Lecture Award of Kyung Hee University.
He served on KIChE (Korean Institute of Chemical Engineers) as president in 2018, and now is a member of National Academy of Engineering of Korea (NAEK). Also, he works on several international journals as associate editor.