Mixing optimization in the batch crystallization of CAM

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The citric acid monohydrate (CAM) is an important organic substance but, until 1997, the scientific literature covered mostly the kinetics of nucleation [4] and the crystal growth [5] rather than its production via the crystallization by cooling in a stirred tank reactor (STR). The Department of Chemical Engineering at the University "La Sapienza" of Rome decided to fill that sci-tech gap through a meticulous investigation, with three STRs at the laboratories of San Pietro in Vincoli's district, on the crystallization in discontinuous (batch) of CAM from aqueous solutions. The author participated in that cutting edge experience, as experimenter and coder under the supervision of Prof. Barbara Mazzarotta, in the years 1997-1998 [1]. Our specific tasks were to spot the main operating conditions, to modify them until an *optimal* crystal size distribution (CSD), i.e., large-sized homogeneous crystals of CAM, and to write a QBasic program predicting the outcomes of any test in batch reactors [2]. Here we focus on the influence of the *agitation*, i.e., the role played by the impellers in crystallizing the CAM thanks to their different shapes and speeds. All the data, collected and simulated, show that the three-blade marine impeller performs better than the Rushton turbine and that a low stirring rate gives the best CSD [3]. The homogenous distribution of large crystals from a low agitated round-bottomed tank, stirred via a 3-blade marine impeller, is due to the *optimal* suspension state that the axial flow provides for the dispersed phase of CAM particles [6], as confirmed by the computational fluid-dynamics software `VisiMix`.

References

[1] Enzo Bonacci. *Studio sperimentale sulla cristallizzazione dell'acido citrico*, volume 40 of *Diritto di Stampa*. Rome: Aracne Editrice, 2013.

[2] Enzo Bonacci. A Pioneering Experimental Study on the Batch Crystallization of the Citric Acid Monohydrate. *Journal of Chemistry and Chemical Engineering*, 8(6): 611–620, 2014.

[3] Enzo Bonacci. The Agitation Effects on the Batch Crystallization of the CAM. *International Journal of Mathematical Sciences and Applications*, 7(1): 65–71, 2017.

[4] Marco Bravi & Barbara Mazzarotta. Primary Nucleation of Citric Acid Monohydrate: Influence of Selected Impurities. *Chemical Engineering Journal*, 70(3): 197–202, 1998.

[5] Marco Bravi & Barbara Mazzarotta. Size Dependency of Citric Acid Monohydrate Growth Kinetics. *Chemical Engineering Journal*, 70(3): 203–207, 1998.

[6] Theodorus Nicolaas Zwietering. Suspending of Solid Particles in Liquid by Agitators. *Chemical Engineering Science*, 8(3–4): 244–253, 1958.