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Caffeine Nucleation Detection Using a Matrix of External Turbidity Probes: Bulk Video Imaging (BVI)

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The purpose of this work is two fold: it describes the proof of concept of the newly introduced bulk video imaging (BVI) method and it presents the nucleation detection in comparison with existing process analytical technologies (PAT) such as focused beam reflectance measurement (FBRM) and ultra violet/visible (UV/Vis) spectroscopy. While the latter two sample the system closely to the probe, the BVI approach monitors the entire crystallizer volume.
The external BVI (eBVI) method is based on a video camera and a capture hardware, which captures 25 frames or pictures of the crystallization bulk per second [1]. It can also be regarded as a matrix of external turbidity probes. Another set of experimental data is generated using in-situ endoscopy and a small scale crystallization calorimeter [2] (iBVI). The eBVI can be implemented as an external sensor providing significantly lower sensitivity to mixing conditions than other probes based on local measurements. Furthermore, the contamination related problems are circumvented. The advantage of the eBVI approach is that it does not require high speed video camera or advanced illumination technologies such as laser or xenon flash. The BVI method is proposed as a complementary PAT tool and it is shown that it is able to detect the nucleation onset with comparable or better performance to the FBRM and UV/VIS probes. Additionally, the endoscopy based BVI is a low cost sensor which can be easily integrated in the existing laboratory hardware and software environments. Recently, multivariate image analysis methods were evaluated for the purpose of nucleation detection [3].

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