Development of a smart sensor for extraction column control

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The development of smart sensors for online process supervision is an increasing trend in the process industry. Here, the optical investigation of a liquid-liquid stirred extraction column DN32 in counter current flow is undergone to differentiate operating states within the column. Two operating states, flooding and regular operating state are differentiated as observable states. Additionally, the diameter of the rising liquid droplets of the disperse phase is categorized into three classes: small, medium and large droplets by a convolutional neural network resnet-18 [1] to infer information on how to more efficiently control the column.

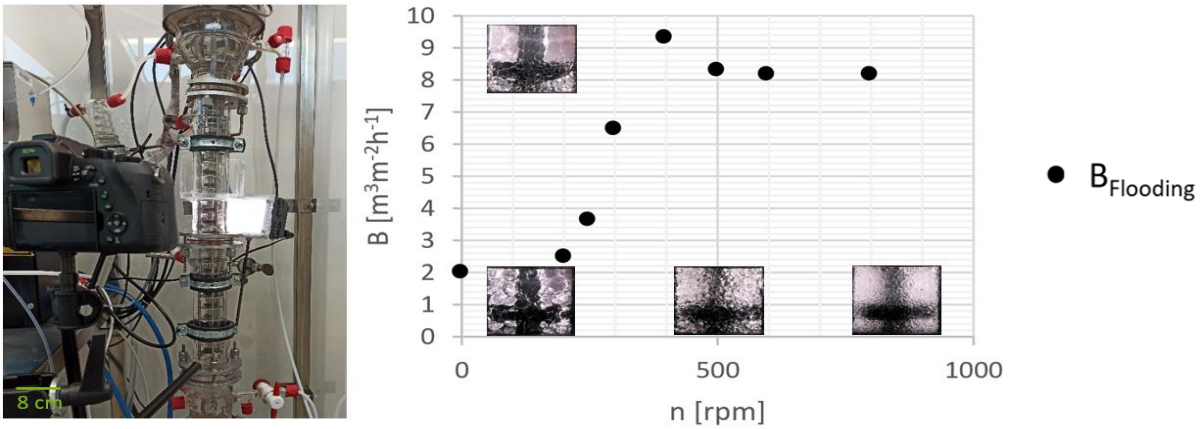

Figure 1 - Setup of the stirred extraction column with mounted sensor (left) and Flooding loading diagram as a function of stirrer speed (right)

The DN32 extraction column can be operated remotely by using Wago SPS and eCockpit to control the in- and outgoing volume flow rates and the stirrer speed. The optical sensor (Panasonic Lumix DMC-FZ2000) detects the current operating state of the column as well as the current droplets' size. Finally, a recommendation on how to run the extraction column more efficiently by adjusting volume flows and the stirrer speed is deduced from this information with the aim to increase the loading of the column. The column operation thus is improved autonomously.

[1] K. He et al., 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), DOI: 10.1109/CVPR.2016.90.