

Doctoral Thesis Summary

"Optimization of the process parameters of the selected nodes of high-pressure plant for melamine production"

The subject of this thesis is an investigation of the melamine synthesis by thermal decomposition of urea, carried out in the Grupa Azoty Zakłady Azotowe Puławy. The aim of the research is to develop primary or secondary measures to mitigate the adverse phenomenon of the deposition of reaction by-products as observed in selected nodes of the industrial plant.

The operational issues observed during the operation of the high-pressure Melamine 2 and Melamine 3 plants were a direct cause of undertaking the research presented in the work. As part of the study, during periodic inspections of the plants, a precise identification of the zones where the most intensive phenomenon of deposition was carried out. An economic analysis was conducted.

The research hypothesis proposed was that the unfavourable phenomena were caused by the presence of reaction by-products that are insoluble under the process conditions in the reaction node. Favourable conditions for their crystallization from the solution were observed in the feed zone of the stripping column.

A comprehensive characterization of the sampled deposits was performed using a series of adapted analytical techniques, determining both quantitatively and qualitatively composition of the samples.

As part of the model studies, a model representing the current state was developed to confirm the research hypothesis. In a domain of the process improvements, the primary measures, research and optimization of the process parameters of the reaction and CO₂ stripping nodes were conducted. Optimal parameters for the operation of the studied nodes were determined.

Equipment improvement studies (secondary measures) involved hydrodynamics modelling using Computational Fluid Dynamics (CFD) tools. Based on the conducted research, a favourable design variant of a deflector was indicated, and additional equipment modifications were proposed based on literature information.

The results of the research confirm the adopted research hypothesis and provide a range of solutions to eliminate the observed problem. The outcomes of the research will be utilized in design and implementation works scheduled for 2024.

Keywords: melamine, melam, melem, melem hydrate