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Model-based real-time prediction of corrosion in Heat Exchangers

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In the chemical and process industry, a variety of thermal unit operations is applied in which gases or vapor mixtures must be cooled down to temperatures near the water dew point. Such mixtures often contain substances which tend to evolve corrosive characteristics in case the temperature unintentionally falls below the water dew point. Depending on the gas composition, acids can be produced and may cause severe damage to heat exchangers. Consequently, most processes operate with a thermal safety distance to the water dew point in terms of pressure and temperature. A considerable drawback of this approach is that the capacity of the heat exchanging equipment is not fully utilized. To overcome such limitations, this paper suggests a process prediction method for the real-time estimation of the lowest possible heat exchanger surface temperature in view of fully utilizing the optimization potential of the process. The key features of the new approach comprise (i) application of rigorous thermodynamics, considering all relevant facility components that are needed for a complete mass and energy balance, and (ii) a rigorous heat exchanger calculation providing surface temperatures and dead zone temperatures for the current thermodynamic state. The thermodynamic calculation provides the theoretical water dew point as a function of the process parameters. Considering that sensitive variables such as the composition of the multicomponent process stream have a significant influence on the water dew point, the accurate thermodynamic description of the complete system poses one challenge of the method. The customized fluid dynamic simulation which is integrated into the simulation model provides the complete spatial distribution of the heat exchanger surface temperatures and dead zone temperatures. Both components are combined to a process prediction model, where an interface between the process prediction model and the process control system (PCS) is used for real-time transmission of the current process parameters to the model, and of recommended process parameters generated by the model back to the PCS. These recommendations can either be used as guidelines for the operator or directly be implemented as PCS command variables in view of an automated optimal operation mode.

Biography

Erich Jeitler has completed his PhD 2008 at Graz University of Technology. He is co-owner and general manager of Prozess Optimal CAP GmbH. The company is an engineering office for chemical and process engineering with the focus on process simulation and modelling. He has been also a lecture at the University of Applied Science – FH JOANNEUM in Graz since 2009.

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