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PROCESS AND CONTROL ENGINEERING MODEL OF AN INTEGRATED FULLY AUTOMATED PIPE-EXTRUSION LINE

M. Sasse [a,*], V. Schöppner[a], S. Seibel[b]

a Institute for polymer materials and processes, Polymer Engineering Paderborn (KTP), University Paderborn, Germany and b battenfeld-cincinnati Germany GmbH, Bad Oeynhausen, Germany

**Corresponding author: miriam.sasse@ktp.upb.de*

Increasing market demands for polymer pipes assume steadily growing levels of manufacturing automation. With increasing process complexity, the demands on the machine operators also grow, as they are exposed to numerous sensors and a flood of information. Owing to this, many researchers and companies are currently developing systems which provide fully automated monitoring methods or innovative control concepts for pipe-extrusion lines. Normally, no control engineering model is available for developing these systems. Such systems can test newly proposed solutions prior to their practical implementation. Currently, control and process engineering models are only separately available. These models have hitherto only been partly coupled and exist in models exclusively for partial extruder processes. An integrated model, which represents the entire, fully automated pipe-extrusion line, has hitherto never been available. Such proposed model solutions could be used to detect extrusion errors early permitting parameter settings to be promptly corrected and controlled.

Within the research project, known and new approaches model process and control engineering responses combined with the results of variance analyses of their influences on quality. Relationships between diverse setting parameters and the product's final quality features were formulated and are available to the model. This paper provides an overview of the potentials and challenges in specifying entire pipe-extrusion equipment and drawing inferences on the final product's quality by using the model and coupling approaches. Transfer functions are treated for the heating and cooling efficiency in the extruder, tooling, vacuum and cooling tanks. Process related design of the cooling sections and influence of such parameters as take-off rates and rotational speeds on such quality features as tensile strengths, surface finish and crystallinity are also treated.

Finally, proposals for implementing this model are presented for optimizing future processes. All sensor data can be matched to the model and optimized setting parameters can be recommended.