Development a Platform of Numerical Calculations of a State Model Based on a Phenomenological Approach: Case of a Clinker Rotary Kiln.

by

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Abstract

This study develops a mathematical platform going from the establishment of a knowledge database to the setting up of an adaptive model. This has required a new approach of modeling of the clinker rotary kiln (CRK). Thus, a state model of distributed parameter systems, based on physico-chemical phenomena, was designed using partial differential equations. The model structure is based on three state variables which are: the gas, clinker temperatures and the clinker mass distributions, and are elaborated with the help of heat, pressure and mass balance equations. The model parameters are defined by the functions of three state variables. Moreover, the resulting state model, decomposed into five phenomenological zones of CRK, is used as a first step to define a set of Operating Functions (OFs). These OFs has also been decomposed into longitudinal distribution of CRK to replace the constant, unknown or unmeasured parameters.

We develop an identification procedure based on phenomenological and dimensional analysis where the identification of operational functions (model parameters) was performed from a stationary state of the CRK. Once the restores state variables have been evaluated, the desired input (which is treated as the control of the CRK) can be more easily found by the proposed model than by simple trial and error.

Moreover, the fact that the computation time, to estimate-calibrate the OFs above-mentioned, is very short, then this dynamic computation works faster than real-time.

In summary, the cooperation and coordination in real-time between industrial computers and the CRK allows for an adaptable model, where each specific set of the OFs must be analyzed by its accuracy.

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