Optimal strategy for feedforward control using inline moisture sensors for raw materials in silicon production

Short application text:

Problem Description: Elkem is currently working on implementing inline sensors for moisture level of raw materials going into their silicon furnaces. The final goal is to have full control of the properties of incoming raw materials. Presently, the moisture is analysed daily by manual sampling.
In a silicon furnace quartz (SiO_2) is reduced by carbon materials to produce silicon (Si). To have an optimal production regarding yield and energy consumption, it is important to adjust the amount of added carbon towards the quartz addition.
The carbon materials used in silicon production are coal, coke, charcoal and woodchips. As these materials are "natural" products, their moisture level might vary significantly over time. The raw material addition to the furnace is controlled by weight, and any errors in the assumed moisture level will lead to addition of non-optimal amount of carbon materials and lead to less production of silicon.

The pre-project phase of the project will involve:

1. Set up a simulation environment for the material flows from the raw material bins to the furnace and the final silicon product for one of Elkem's silicon furnaces.
    - The simplified model should describe the material flows (ton/h), the material mixing and the main time dynamics (time delays, transport delays) through the different silos and the furnace. The model should include moisture variations in raw materials.
2. Investigate how the continuous inline moisture signal should be used to compensate for moisture variations in incoming raw materials. This will include simulation studies of different control strategies, optimal filtering of the moisture signal and evaluation of different placements of the moisture sensor in the raw material system.

The pre-project may lead to a masters project on improved control of silicon furnaces. Presently, the topic is not defined yet, and it will be adjusted towards the student's interests.

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