Virtual training for real quality

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Today it is impossible to think of one airline not employing professional flight simulators for the training programmes for their pilots. Although these pilots gather flight experience every day, simulator training seems to be indispensable to comply with safety and quality targets. The noticeable progress of information technology caused the significant improvement of today’s simulator systems at proximity to reality both regarding the underlying modelling and regarding visualisation and operation behaviour.

Many reasons underline that also in the cement industry the increasing use of simulators will be established in the future. Simulator training offers the following advantages:

- training of control behaviour without endangering production equipment
- intentional triggering of stress situations
- individual training and evaluation of trainees
- fast and structured transfer of knowledge
- safe optimisation of the set of guidance-rules for the production
- an unbeatable price/effect ratio to avoid risks of machinery damage especially in critical operation phases, eg initial commissionings of new process equipment and technology.

KHD Humboldt Wedag has developed and realised fastidious simulators for the cement industry for more than 10 years. The third version of the cement plant simulator SIMULEX demonstrates the latest technology and has become the standard of the cement industry. Not only do world leading cement producers such as Lafarge and Cemex run SIMULEX systems for their worldwide corporate training programmes, but also a lot of smaller producers, as well as honourable institutions such as the German cement works association (VDZ), have chosen to use SIMULEX in its courses for the training of the operators and production personnel (see Figure 1). A co-operation agreement between the VDZ and KHD Humboldt Wedag AG guarantees that valuable experience from operational practice flows back into the advancement of the simulator.

Principle function

The automation components of a cement production line on their respective levels, as well as their corresponding counterparts in the ‘virtual reality’ of the simulator are shown in Figure 2.

On the lowest level, from the automation point of view, the production line is described by numerous machines, drives, control units and of course by its process equipment as such. In the virtual world of SIMULEX, these components and, most importantly, their interactive behaviour are transferred into dynamic models. These models are, basically, the core of the simulator. At any time, several hundred linked dynamic variables with digital and similar values are computed simultaneously in SIMULEX. This closed model covers the entire production process from the raw material bins to the cement silos.

On the next automation level of the
The simulator at the interface between automation and training programmes

The interface between operating personnel and production line technology is described in Figure 4. The task to optimally operate a cement production line can be described as the optimisation of the interaction between man and technology/machine. In principle, this interaction is handled by what is called 'the automation'. According to the basic characteristic of this communication system, this process can be optimised in both directions: on the one hand toward technology/machine, on the other hand toward operating personnel. The first has been fulfilled by optimiser-systems for already quite some time now. A simulator now represents a tool with which the man/machine interface can be optimised towards the operation personnel. Despite today's already quite efficient optimiser-systems, this is necessary, because human intelligence is still indispensable due to the complex and often erratic behaviour of a cement production line.

As shown above, the employment of a simulator does not stand in opposition to the application of optimiser-systems. It neither replaces these optimisation systems, nor does it represent any redundancy of them. The optimisation of the operation of an individual production plant with all its singular specifics in a given operating situation is the task of optimisation systems and always should be. These tools work with methods, which allow to aim for an optimal operating point, as fast as possible, but also within certain limitations. However, the often offered optimiser/simulator combinations do not fulfil the requirements of a simulator system, especially if they do not cover the entire production unit with all its interaction amongst the several departments and if they do not support the required learning methodology.

Simulator requirements

From the above remarks on the objective of a simulator application result certain requirements, which a simulator system must fulfil. These requirements can be classified into two categories:

Figure 2: comparison real cement production line vs its SIMULEX 'virtual reality' counterpart

Figure 3: screenshot of the graphical surface of SIMULEX
• Automation controls and optimises the interface between man and machine
• Optimisation improves the efficiency of the machine
• Training improves the skills of man