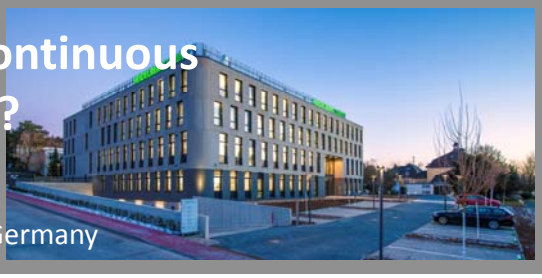
Proficiency Testing – a Tool for Continuous Analytical Improvement?



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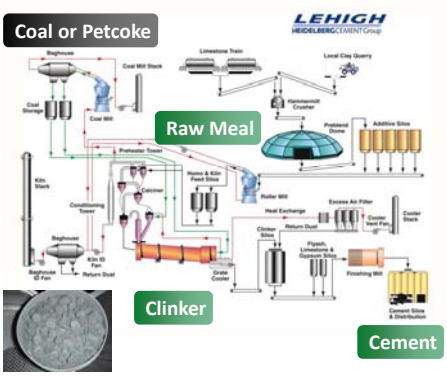
Introduction

Since 2006, HeidelbergCement has been running two proficiency testing schemes, covering the analyses of the most important intermediate and final products:



Key Issue

In order to realize cost savings and to guarantee customers constant product quality, process fluctuations and product variability need to be minimized as far as possible.

However, thorough monitoring of such fluctuations requires accurate and reliable analysis as decision-making basis for operators or automated control loops.

Does proficiency testing provide the basis for continuous analytical improvement and thus for operational excellence?

Methods

Ten years after reorganizing its proficiency testing schemes, HeidelbergCement reviewed the effectiveness of this costly measure by looking at three basic statistical evaluations:

- Percentages of satisfactory analysis results
  - Expected to increase over time
- RSD (Relative Standard Deviations)
  - Expected to decrease over time
  - Heavily affected by outliers
- RRSD (Relative Robust Standard Deviations)
  - Expected to decrease over time
  - Impact of outliers minimized
  - Expected to be lower than the RSD

In addition to this parameter-related evaluation, the analytical performance development over time was analyzed for selected laboratories participating throughout the entire period.

For certain parameters and participants, individual examples for best performance development were identified and graphically illustrated.

Results

The following charts show selected examples resulting from the detailed statistical evaluation over the period from 2006 to 2015 (four rounds per year, up to 83 participants per round).

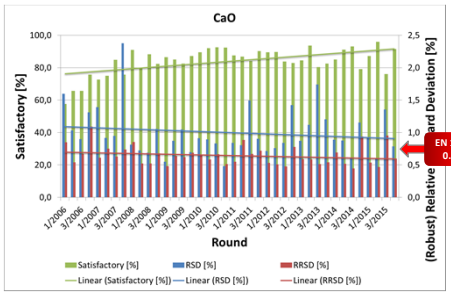


Chart 1. XRF analysis of raw meal (CaO content as major process-relevant parameter).

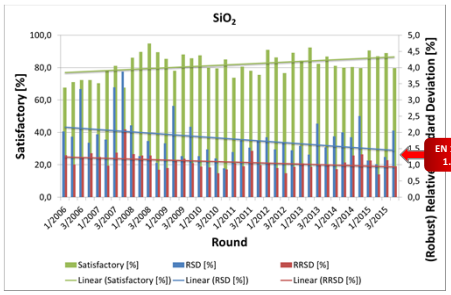


Chart 2. XRF analysis of cement (SiO_2 content as major product-relevant parameter).

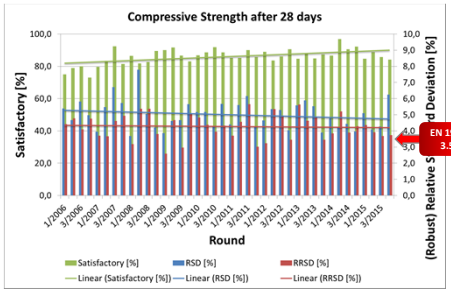


Chart 3. Physical-mechanical parameters of cement (28-day compressive strength as main indicator for cement strength class).

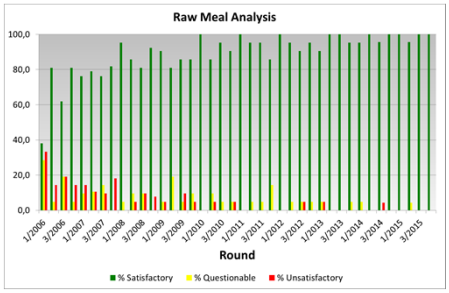


Chart 4. Performance development of participant 25 over time, considering 24 different raw meal parameters per round.

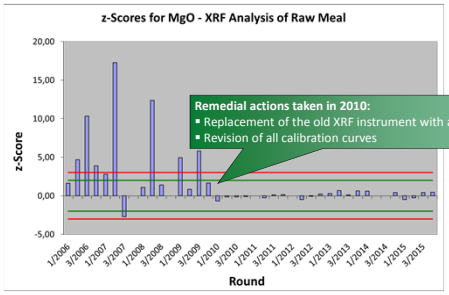


Chart 5. Individual example for best performance development: Long-term review of participant 25 (MgO content of raw meal).

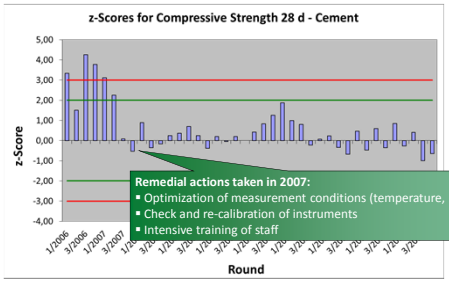


Chart 6. Individual example for best performance development: Long-term review of participant 45 (28-day strength of cement).

Discussion

The study confirmed a substantial improvement of the analytical performance level: Based on the increase in the percentage of satisfactory analysis results, for cement, 42 of 49 evaluated parameters (85.7%) improved, for raw meal, 21 of 24 evaluated parameters (87.5%) improved.

For most parameters, the relative robust standard deviations could be lowered to a level meeting the requirements of the relevant standards and of adequate process control ("fitness for purpose").

Conclusions

The achieved analytical excellence was the basis for the operational excellence program and the resulting cost savings, which was not only helpful to justify the considerable expense for conducting these internal PT schemes, but also made them an extremely useful tool for the integration of several other laboratories after a major acquisition in 2016.

The review also helped to identify those critical parameters, which could not be improved and need particular attention in the future, and those participants having most room for improvement.

Based on the outcome of the individual reviews, further actions can be triggered, for example the enforcement of quality audits or the investment in laboratory infrastructure, equipment or training.

In the end, it was the combination of all these measures and the efforts of the lab staff, which made internal proficiency testing a success story.

Contact

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