Fate and distribution of film forming and alkalizing amines in steam-water cycles

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Boiler water treatment and conditioning are employed in most industrial plants to control corrosion. The plant of the steam-water cycle studied here switched its treatment program in 2013. The former treatment program was based on hydrazine, tri sodium phosphate and ammonia. Due to boiler tube failures with this treatment, a program based on film forming amines (FFA) and alkalizing amines (AA) was implemented instead. After the transition no further boiler tube failures occurred. Moreover, considerable water and energy savings could be realised.

Although FFA based treatment has been used successfully for years, more studies are needed for a comprehensive understanding of the exact mechanisms behind the corrosion protection of this treatment concept in steam-water cycles. The ISPT Joint Industrial Project 'Steam and Condensate Quality Water Process Technology' addresses this need.

Within the ISPT framework, the goal of the study presented here is to get detailed insight into the distribution of FFA and AA and their major breakdown products in the steam-water cycle of the plant mentioned above. Therefore, lab-scale flow-through boiler experiments were combined with a sampling campaign in the full-scale steam-water cycle.

Lab-scale boiler experiments were performed to study the thermal stability and potential breakdown products of the FFA and AA. The lab-scale flow-through boiler was operated at conditions mimicking the plant's superheater conditions. Samples prior and after thermal exposure were collected for analysis. An extended sampling campaign was run in the plant, whereby several sampling points were selected throughout the steam-water cycle to analyze the distribution of relevant components of the treatment chemicals and breakdown products in the system.

The water samples were submitted to regular monitoring scheme. Furthermore, several specialized analytical methods were used, such as liquid chromatography-mass spectrometry (LC-MS), ion chromatography (IC) and gas chromatography-mass spectrometry (GC-MS).

Based on the obtained results a first attempt to model the behavior of the components in the steam-water cycle will be presented.