PPCHEM

Report on the third Power Cycle Instrumentation Seminar in Beijing, China

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ABSTRACT

The third Power Cycle Instrumentation Seminar was held in Beijing, China, on June 18–19, 2016. The seminar consisted of two sessions: The presentations on the first day were dedicated to the choice of appropriate chemical treatments for water/steam cycles. Experts from China and abroad presented case studies on the conversion of the chemical regime in coal-fired units as well as on the choice of a chemical regime for newly built heat recovery steam generators.

The second session focused on the management of cycle chemistry. Enough time was given for plenary discussions in which the participants and speakers could discuss the presentations from the first day and use the possibility to exchange ideas with their colleagues from all around the world. The second session was completed with presentations on advances in on-line monitoring and the latest developments regarding the PowerPlant Chemistry Journal.

A short summary of the two days is given in this report.

INTRODUCTION

In the past three years, Waesseri GmbH has organized several Power Cycle Instrumentation Seminars around the world with the mission of expanding the knowledge of cycle chemistry and the understanding of analytical instruments [1–3], with two of the past seminars held in Beijing, China. Based on the feedback from the past two seminars, Waesseri GmbH decided to organize the third event in China with even more time for the participants to discuss and to share knowledge and experience with their colleagues from other power plants and with the international experts. The main focus of the seminar has shifted slightly as it does not concentrate on sampling and instrumentation only but instead includes a wide variety of power plant chemistry topics.

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The seminar was moderated by Jieyu Cao, Director of the Power Plant Chemistry Technical Department at the Thermal Power Research Institute (TPRI).

A short summary of the presentations will be given in the following sections of this report.

THE CHOICE OF APPROPRIATE CHEMICAL TREATMENTS FOR WATER/STEAM CYCLES

Opening Speech

The first session was opened by Barry Dooley, Senior Associate at Structural Integrity Associates, Inc. Barry Dooley is the Executive Secretary of the International Association for the Properties of Water and Steam (IAPWS) and a member of the PowerPlant Chemistry Journal's International Advisory Board. In his opening speech, Barry Dooley introduced the member countries, the working groups and the technical guidance documents of IAPWS to the audience.

In his function as the Executive Secretary of IAPWS, Barry Dooley encouraged the attendees to form a national organization in China and to join IAPWS for the exchange of experiences, ideas and results of research in power plant chemistry.

Case Study 1

The first case study of the seminar was presented by Xiaoni Zhang, Deputy Director of the Environmental Protection Department at State Grid Henan Electric Power Company. Xiaoni Zhang presented a case study about the conversion of the feedwater treatment from all-volatile treatment under reducing conditions (AVT(R)) into weak oxygen treatment (WOT). This conversion took place in a coal-fired (ultra) supercritical once-through boiler with an installed capacity of 600 MW, rated main steam temperature of 566 °C and rated main steam pressure of 24.2 MPa.

The primary problems with the initial feedwater treatment (AVT(R)) were the following:

- High salt accumulation rates on the steam turbine blades, high scale rates in the economizer and the waterwalls.
- Average interval for chemical cleanings was about 2–3 years.
- Reduced efficiency because of feedwater pump head rises due to deposits in the high-pressure heater inlet.

Due to the above-mentioned problems, the plant operators decided to change the feedwater treatment to WOT. With this treatment method, the oxygen is dosed in very low concentrations into the feedwater to prevent oxygen entering into the steam. A comparison between the surfaces of the turbine blades before and after the conversion showed good results.

Case Study 2

The next presentation was given by Randy Turner, technical director of SWAN Analytical Instruments, USA. Randy Turner is chairman of the American Society of Mechanical Engineers (ASME) Power Plant and Environmental Chemistry Committee, an advisory board member for the International Water Conference, a member of the IAPWS PCC Working Group, and he is on the American Water Works Association (AWWA) Online Monitoring Committee. The case study showed how a power plant changed its chemical regime from AVT(R) to all-volatile treatment under oxidizing conditions (AVT(O)). The plant under discussion is a coal-fired unit with a controlled circulation drum boiler, copper condenser tubes, and copper alloy feedwater heaters.

The originally implemented treatment system was AVT(R) with the appropriate monitoring equipment but the following problems occurred:

- The chemistry for either metal (carbon steel and copper alloys) could not be optimized, which resulted in increased corrosion of both iron and copper and finally to more frequent boiler chemical cleanings.

– Steam drum liner cracks occurred, which resulted in increased mechanical carry-over and finally to turbine deposition.

After an assessment, the plant operator decided to make some modifications to the metallurgy as well as the chemistry of the unit:

– to replace the drum liner,
– to replace copper alloy feedwater heaters with stainless steel feedwater heaters,
– to change the chemistry regime from AVT(R) to AVT(O),
– to upgrade the sampling system and instrumentation.

The decreased mechanical carry-over due to the repaired drum liner resulted in reduced turbine deposition (copper, sodium, silica). Replacing the copper alloys in the feedwater heaters allowed the cycle chemistry regime to be changed to AVT (O), which reduced iron corrosion and therefore reduced chemical cleaning frequency.

While the first two case studies were focused on coal-fired units and the conversion of the chemical regimes, the following two case studies discussed the challenges faced in newly built combined cycles /HRSGs.

Case Study 3

The first presentation was given by Ying Zhao, Senior Chemistry Executive of the Production Department at Datang International Power Generation Co., LTD. Ying Zhao discussed the chemical supervision of a combined cycle power plant located in the Shijingshan District of Beijing, China. Commissioned in 2014, the newly built power plant exports electricity and heat to the west of Beijing, running 4 100 h per year with a 50–95 % load. The boiler is a horizontal, triple-pressure, reheat, non-after-burning or duct burner natural circulation HRSG. The chemical regime chosen for the feedwater is AVT(O), with the pH kept between 9.2–9.6.

After the introduction to the metallurgy, the makeup water treatment system and other relevant data of the unit, Ying Zhao discussed problems, which occurred in the first year of operation.

A first problem was the elevated conductivity after cation exchange (CACE) in the low-pressure superheated steam. One suspected cause for the elevated CACE is the missing condensate polishing plant and the high amount of ammonia in the steam due to vapor-liquid partitioning.

The second topic was the layup protection to prevent corrosion. The operation principle of the gas turbine unit is to produce electric power when producing heat for the district heating system. Thus, the unit has a long layup time during the summer half year that means the layup protection becomes a frequent operation. In the case of 2 · 1 unit (one steam turbine driven by two HRSGs), it is hard to optimize the water/steam quality of the operational unit and layup protection of the other unit when only one HRSG is in operation, while the other is shut down. Another problem related to layup protection is the heater for the district heating network. It has a large configuration resulting in poor gas tightness and therefore it is difficult to meet the required concentrations of nitrogen during layup.

The third topic was related to the chemical cleaning of the three-pressure reheat HRSG. With different pressures and temperatures, the scaling rates on different heating surfaces vary considerably; therefore, the chemical cleaning procedures for different heating surfaces should be set up separately.

Case Study 4

The last case study of the seminar was presented by Manuel Sigrist, CEO at SWAN Systems AG. Manuel Sigrist presented a project, in which an open cycle plant was extended to a combined cycle power plant with multiple-HRSGs. The originally built open cycle plant consisted of four gas turbines with a total capacity of 280 MW. After the plant was commissioned in 2012, the plant owner decided to install four dual-pressure vertical HRSGs and one steam turbine to add another 147 MW capacity.

After the first project introduction, an overview of the plants physical dimension as well as a short introduction to the metallurgy (all-ferrous) and a balance of the water/ steam cycle were shown. After this introduction, the case study showed typical problems and challenges plant owner, boiler manufacturers and system engineering companies face when planning a new HRSG:

- Choice of water chemistry.
- Selection of required instrumentation.
- Definition of appropriate sampling and condition system

Typical pitfalls were made clear with the help of the project under discussion.

Choice of a Chemical Regime According to IAPWS

Following a tea break Barry Dooley held his second presentation of the day. This time he gave a more detailed presentation about the IAPWS Technical Guidance Documents (TGDs) and how they can be used to choose the right chemical regime in fossil and HRSG/combined cycle plants. The main message of the presentation was that the TGDs could be customized to any generating plant in the world.

With a couple of examples from the case studies previously presented, he showed how the TGDs work and how to use them to achieve optimum cycle chemistry conditions. The TGDs were developed by IAPWS to provide international cycle chemistry guidance and that the TGDs represent the accumulated experience of members of the IAPWS Power Cycle Chemistry (PCC) Working Group with expertise from 21 countries. All TGDs are freely available and can be downloaded from the webpage [4].

After a final plenary discussion, the first day's official program ended and the participants were invited to join the dinner and evening reception.

MANAGEMENT OF CYCLE CHEMISTRY

The second day started with a plenary discussion in which the attendees could use the opportunity to discuss with the experts from China and abroad. The plenary discussion was very fruitful and was used intensively to share and discuss experiences from the attendees' own plants with the local and international colleagues.

After a tea break, Randy Turner presented the latest developments in online monitoring followed by another plenary discussion. The Seminar was concluded with a presentation about the PowerPlant Chemistry Journal, held by Tapio Werder, Editor of the journal and Amy Xu, representative of the PowerPlant Chemistry Journal in China.

With this final presentation, the seminar's official program ended and the participants were invited to lunch.

CONCLUSION

The third Power Cycle Instrumentation Seminar in Beijing, China attracted over 40 station chemists, managers, technicians, and engineers. The feedback from the audience was very positive. In order to serve as many people within the industry as possible, the next event in China is already being planned. Future dates, venues, and other details will be published in this journal as soon as they are available.

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