Organic Plant Cycle Treatment Chemicals – A PowerPlant Chemistry Interview

In the last twelve months, nine papers have been published in this journal dealing either exclusively or largely with the behavior of organics in the fossil plant cycle. You may find a list of these papers in the August issue of our journal on page #468.

Surprisingly, the major focus of these papers is not on natural organics, extractables, or leachables from ion exchange resins; organic plant cycle treatment chemicals are the main theme. As you might expect, these papers are not able to address all aspects of this very complex topic. The fact that such papers are written, read, and discussed substantiates the need for more information relating to this subject.

The PowerPlant Chemistry editor has received many e-mail requests asking for more detailed information. Although we would like to respond to all these e-mails as correctly and precisely as possible, we do not possess all the necessary data.

For this reason, we have decided to contact major suppliers of organic plant cycle treatment chemicals and ask them the questions that we have received from our readers. The first interview in our interview series appeared in the August issue of our journal (PowerPlant Chemistry 2009, 11(8), 468–474), the second in the September issue (PowerPlant Chemistry 2009, 11(9), 516–518). This time, our interviewees are Pierre Bezzoli and Karsten Cramer, jointly representing the producer of Fineamin.

QUESTION #1:

Pierre and Karsten, first we would like to thank you for your willingness to respond to representative questions from our readers. Let us start with the most frequently asked question: Who are the typical users of your chemicals? Are these public and private utilities, industrial steam and power generators, or operators of combined cycle units with heat recovery steam generators?

ANSWER

Most of the plants treated with FINEAMIN water treatment additives are private utilities operating conventional steam boilers or heat recovery boilers. Other applications are industrial steam, power generators and district heating systems. But we also supply FINEAMIN to all sizes and kinds of customers.

The surface active (filming) polyamines we use are not injected alone, but together with other components like alkalizing volatile amines and dispersing, sequestering polymers. The important point is that our products include special polyamine and polyacrylate types which are of the highest quality. Our chemists and engineers have more than 25 years of experience in using polyamine-based treatments and are able to adapt the water treatment to each particular plant and situation.

The quality of the FINEAMIN products and the application method, based on our experience, allow us to reach the best level of protection and cleanness in the plants, all this having been proved by the results we have been able to reach and maintain in many hundreds of large size plants over the last 25 years.

QUESTION #2:

What are the largest units in which your products are in use? Can you give us some examples? Please state either the unit capacity in MW or the steaming capacity in t/h.

ANSWER

Our products have been used in large units in many fields (customers operating high-pressure steam generators) in different countries and many different industries. In refineries, operators producing a total of 12 500 $t \cdot h^{-1}$ steam with pressures between 40 and 120 bar use FINEAMIN additives and have not had any problems, even in any sensitive refinery processes, including in catalyst-based reforming and cracking processes.

We are also treating industrial steam and power generating plants producing a total of 4 700 $t \cdot h^{-1}$ steam with operating pressures of 74 to 210 bar and 400 MW electric power.

A typical example is an electricity plant with four boilers and four turbines with a total steaming capacity of 920 $t \cdot h^{-1}$ at 136 bar operating pressure and an electric power output of 240 MW. Another example is a plant with six boilers and four heat recovery steam generators with a total steaming capacity of 5 000 $t \cdot h^{-1}$ at 100 bar working pressure, producing electricity and feeding sea water evaporators, which also applies FINEAMIN additives.

QUESTION #3:

Are there any restrictions (for example steam pressures and temperatures) with respect to the applicability of your products? It is generally known that different organic chemicals behave differently, e.g., at high temperatures. Some organics are relatively stable; others are subject to fast decomposition. We assume that, for this reason, it will not be very easy to answer this question. Nevertheless, please state any such limits and use the international (SI) units. Although most readers of our journal come from the United States, a considerable part of our readership comes from countries in which the use of US units is not common.

ANSWER

In the plants mentioned in point 2, we have overheated steam temperatures up to 545 °C.

Based on our experience and due to the quality and application method of the FINEAMIN products, the degradation products resulting from the organic components of these additives (not only the filming polyamines, but also the other components such as alkalizing amines and dispersing polymers) do not have negative effects on the results of the water treatments.

QUESTION #4:

We have almost forgotten to ask you whether your additives are used exclusively in units or plants with circulation steam generators or are also used in units or systems with once-through steam generators. Please comment.

ANSWER

We have also been treating once-through boilers (Benson-type) with operating pressures of 210 bar for a long period. Compared to traditional treatments based on hydrazine and ammonia, the iron level has decreased and the capacity of the polishing plant has increased (mainly due to the substitution of ammonia).

QUESTION #5:

In many discussions about the pros and cons of organic additives, one topic is often very controversial – the possible negative effects of decomposition products of organic additives on steam turbine disks and blades. This is clearly not relevant for back-pressure turbines. However, it is supposed that the presence of decomposition products in early condensate or films on the surfaces of blades and disks of condensing turbines may result in corrosion or cracking of these turbine parts. A two-part question in this connection: Are your products also applied in plants with condensing turbines, and – if the answer is YES – what is your or your customers' experience.

ANSWER

In the many cycles with condensing turbines we treat, we have observed a slight increase in the cation (acid) conductivity of the steam. For example, in the plant generating 5 000 $t \cdot h^{-1}$ steam at 100 bar mentioned in point 2, we measure cation conductivities between 0.15 and 0.28 $\mu S \cdot cm^{-1}$. Such a level of conductivity is partially caused by the degradation products, but is mainly due to the presence of CO_2.

In 15 years of experience in large size steam generating plants, we have never faced problems due to first condensate corrosion, since the neutralization and protection effect of our products is remarkably efficient in this part of the plant.

QUESTION #6:

High-pressure utility cycles with circulation boilers are very often equipped with condensate polishers, and cycles with once-through steam generators almost always. Do you have any experience with respect to the possible interactions between organic additives or their decomposition products and ion exchange resins? It is expected that different amines may affect the ion exchange resins in different ways. For example, film-forming amines are suspected of irreversible adsorption on polisher resins. Can you comment on this issue?

ANSWER

The effects and influences of amines on polishing plants (ion exchangers) can be summarized as follows:

Concerning the filming polyamines, observation of the capacity and quality of the resins over a long period in running plants has not shown any negative changes in these parameters. The capacity of desorption/absorption of the resins certainly explains this result. However, the quality and quantity of polyamines used in the formulation of the products certainly play the first and foremost role in this regard.

The alkalizing amines are simply loaded on the resins and are removed during each regeneration.

QUESTION #7:

From a great many industrial plants it has been reported that the use of organic plant cycle treatment chemicals has

markedly reduced corrosion product generation and transport in often very complicated systems with large steam and condensate networks. Who are the typical industrial users of your additives and what are the typical results of their application of your products? Please give us some examples.

ANSWER

Our products are very efficient in large reticulated systems, like refineries with steam networks with a length of more than 70 km. The volatility of most of the components allows protection of the whole plant, particularly steam and condensate lines. In each case, due to the better protection of the plant, we observe a reduction in the corrosion product generation and transport. The remarkable passivation of the whole circuit allows a total iron level lower than 0.01 $mg \cdot kg^{-1}$ to be achieved.

During the first period of treatment, a slight increase in the iron level due to the cleaning effect can be observed. During this phase, our technical staff adapt and monitor the treatment in order to reach the best result in the shortest period.

QUESTION #8:

Two types of corrosion seem to be very difficult to cope with: flow-accelerated corrosion (appearing in both variants, single-phase and two-phase) in condensate and feedwater trains in all plant cycles, and corrosion of ducts and tube entries in air-cooled condensers. What is your assessment with respect to the mitigation or avoidance of these corrosion processes with the help of organic plant cycle treatment chemicals?

ANSWER

Flow-accelerated corrosion is due to high and too high velocity of steam and water. In many cases, it is also coupled with insufficient protection of the surfaces. The presence of a strong, tenacious protective film can only have a positive effect on this problem.

QUESTION #9:

We have not yet addressed the most delicate issue, the cation conductivity increase in steam, condensate and feedwater when organic additives are applied. This issue is very often adduced by all those opposed to organic additives. This point of view is absolutely understandable – cation conductivity monitoring is the most important tool for the plant cycle chemistry surveillance. An increase due to the presence of decomposition products of organics may mask contamination of the cycle by salts of strong inorganic acids. What is your opinion or experience? Could you please state the typical cation conductivity of the steam in cycles in which your additives are in use? Please also comment on this exasperating monitoring issue.

ANSWER

This question has already been partially dealt with above (see points 3, 5 and 6).

The slight increase in cation conductivity we have observed in the plants treated with filming-amine-based products has not had a negative influence on the treatment efficiency. A big part of this conductivity increase is due to CO_2 and studies on first condensate corrosion have shown the efficiency of this type of treatment. And, the benefits of this treatment (elimination of dangerous, carcinogenic chemicals, better protection of the whole plant, etc.) have to be taken into consideration.

It is clear that the high quality of the products, their effective application in the plants and having experienced chemists/engineers in charge of supervising the treatment are three conditions that have to be fulfilled to achieve an efficient water treatment.

This will allow the optimal quantity of product to be injected and the conductivity increase to be kept as low as possible.

Since filming polyamines are not used alone, but always in a blend containing other important components, only a product made of first quality elements, selected for their effective action and behavior in a steam generating plant, can achieve a good result, minimizing or eliminating the secondary undesirable effects on the plants.

We have come to the end of this interview. What is the most important additional message that you would like to deliver to our readers? Any technical or scientific-based information is welcome.

The different answers are based on facts and 25 years of experience in polyamine-based steam generating plant water treatment. We are continuously improving our products and the quality of our technical assistance.

Our customers are the first beneficiaries of the results reached with this treatment and we appreciate the very interesting exchange of experience we have with them. This allows us to improve our efficiency and with the cooperation of all, we are at the customer's full disposal to help solve the problems faced and to suggest the best solution economically and technically.

We greatly appreciate your taking time out to participate in this interview. Our readers will certainly be very interested in what you have had to say. Thank you very much!

Our interviewees were
Pierre Bezzoli representing h2o facilities sa in Switzerland and **Karsten Cramer** representing CWB Wasserbehandlung GmbH in Germany.