Prepared Discussion of:

The Thermal ZLD Experience for FGD Wastewater at PSNH's Merrimack Station

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OVERVIEW

The paper summarizes the design of a physical-chemical Flue Gas desulfurization (FGD) wastewater treatment system and an accompanying Zero Liquid Discharge (ZLD) system installed at the Merrimack Power Generating Station in New Hampshire. The authors extensively discuss the various unit processes and the regulatory drivers behind the decision to choose a ZLD alternative.

This discussion examines the paper by first presenting general comments on the overall structure and format of the paper, and then by listing more specific comments that address the details of the paper.

GENERAL COMMENTS

The paper comprehensively discusses the various unit processes and sub-systems of the wastewater plant. However, throughout the paper there is an overall lack of detail that would allow the audience to more closely evaluate the system's operation.

What is the goal of the paper, and what is the intended audience? The paper goes to great length to describe the system, but without clearly emphasizing how this could impact or help owners or engineers attending the conference. The authors may want to consider focusing the thrust of the paper around an overarching goal, and tailoring the paper to that goal throughout. Examples of possible focuses include the following:

Is the goal of the paper to illustrate how implementing ZLD can streamline and accelerate the NPDES permitting process? The paper presents good background on the regulatory aspect of the project, but could be clearer on specific advantages of ZLD over NPDES discharge.

Does the project use unique or novel technological approaches that advance the state of the industry or provide benefits to the owner that other systems could not provide?

If widely available technology was implemented on the project, was is implement via a novel approach that provides advantages over comparable approaches?

SPECIFIC COMMENTS

The authors do a good job of describing the scope of the design, and the various unit processes involved in the overall system. The following specific questions and comments are posed in an effort to clear up any ambiguity or content questions in the paper.

GENERAL FORMATTING - Several of the figures and tables have awkward column or page breaks, or extend beyond the paper margins. The formatting of these tables and figures should be fixed.

FIGURE/TABLE COMMENTS - The layout of the ZLD system is illustrated throughout the paper via several process flow diagrams of the various sub-systems and interface points. The reader would be better served by one overall system Process Flow Diagram, with the subsystems designated by boundaries (i.e. dashed lines, etc.). This would greatly enhance the readers' comprehension of the overall integrated system and how it ties together.

The PFD shows only one stream out of the hydrocyclones. Show both streams. This comment carries through to all other major streams such as backwashes, blowdowns, solids wasting, etc.

On the overall PFD, show clearly the locations in the process that are reflected by the water quality data in Tables 1, 2, and 3. Graphically tying together the PFDs and the mass balace tables would clarify performance for the reader.

There is discussion of the first EQ tank being the source of backwash water for the EMARS system for mercury removal. Can you include this and other relevant backwash and secondary streams on the PFD?

Although the influent flow of the system is clearly described (65 gpm), there is little information tracking flow rate (i.e. the concentration of water) through the various sub-systems. Given that the entire function of the ZLD system is the reduction of water volume, this would be relevant and interesting to include.

SPECIFIC TEXT COMMENTS - Under the heading "First and Second Effect" there is a discussion of the crystallizer reject stream. Would this be more accurately described as the crystallizer blowdown stream?

There is a storage tank for crystallizer blowdown, to be later used for fly ash wetting. What is the volume of this storage and how long is it held? Describe the solids concentrations in this stream, and any challenges related to mixing and fouling under extended storage conditions.

The high temperatures and high chloride concentrations in ZLD systems lead to challenging materials suitability issues. What procedures were followed to determine optimal alloys for vapor body construction? Was there a life-time expectancy from the owner that drove the selection process?

More clearly illustrate and discuss the solids balance around the evaporator and hydrocyclone, specifying where concentration occurs vs. actual crystallization and production of suspended and settleable solids.

The paper states that there is a 200 micro-ohm maximum limit on the First Effect effluent. Is there also a lower limit to acceptable resistivity that will help prevent corrosion of downstream metallic components and materials from low resistivity water?

The remote location of the Soda Ash silo and mix-down system resulted in the installation of underground soda ash dosing lines in order to reach the treatment plant. Have there been any line fouling issues, and if so, has the owner devised a way to address them without digging up the buried lines?

The “Salt Generation” section of the paper discusses salt cake quality. How is that quality measured; Consistency, particle size, purity? Describe how this is a pure or mixed salt system and how various aspects of system design determine this.

Where do the solids from the Belt Filter press go, and how are they conveyed or transported there?

What modifications were made to the Phys-Chem system’s upstream Equalization Tank to convert it to a settling tank? Was a rake mechanism installed? Did the floor geometry (flat vs. sloped) present any problems in solids removal from this tank?

CONCLUSIONS

While the paper adequately summarizes the general configuration of the FGD and ZLD treatment systems, it is fairly light on specifics that would otherwise illustrate its performance and its advantages over comparable systems to the reader.

The paper does a good job presenting the regulatory background on why ZLD was chosen, but the discussion is fairly qualitative.

The paper lacks a clearly stated focus or argument as to why or how the selection of this specific approach or technology provides unique or valuable advantages to owners of similar facilities. Is the NPDES angle the main driver towards ZLD on this specific project? And once ZLD was selected as a general approach, how has the selection of the specifically implemented approach and equipment proven advantageous to the owner?