From:	Kekeisen, Kyle
To:	Read, David
Cc:	Harrington, Jeff; Russ.Perry@bp.com; Santiago.Arcila@bp.com
Subject:	(Archived w/ Attachments) Response to Sulfuric Acid Mist Question
Date:	Wednesday, September 26, 2012 5:39:18 PM
Attachments:	EPRI2012a_EstimatingSAMfromPPs.pdf

David,

Per your request, BP Biofuels – Highlands and AMEC have reviewed the potential for sulfuric acid mist (SAM) emissions from the biomass boiler. As you are aware, the predominant sulfuric oxides (SO_X) emissions from combustion are SO_2. A portion of the SO_X is in the form of SO_3, which in the presence of water vapor, can be converted to SAM in the exhaust gases. This is a relatively well-studied phenomenon in oil-fired and coal-fired boilers, where SAM typically comprises 4 to 6 percent of the total SO_X emissions on a mass basis.

The Electric Power Research Institute's (EPRI) Estimating Total Sulfuric Acid Emissions from Stationary Power Plants, 2012a (Technical Update April 2010, attached to this email) provides recent information on the formation of SAM emissions in boilers fired with fossil fuels. This documentation provides equations and fuel impact factors for SO_3 formation for various fossil fuels based on flue gas SO_2 and mathematical relationships. This methodology has been used in major New Source Review (NSR) permit applications and in support of Best Available Retrofit Technology (BART) plans for power plants in various states. Using Equation 4-1 and the fuel factors found in Table 4-1 of EPRI's report, SAM emissions resulting from natural gas and No. 2 fuel oil combustion are approximately 1.5 percent of the SO_2 emissions, whereas SAM emissions resulting from No. 6 fuel oil combustion are approximately 4 percent of the SO_2 emissions.

For biomass combustion, however, less data are available. The National Council on Air and Stream Improvement (NCASI) has performed some studies on bark combustion and on the co-firing of bark with oil and coal. These studies have consistently shown that SAM emissions are generally much less than found when combusting fossil fuels alone, with SAM comprising less than 1 percent of the total SO_X emissions on a mass basis. The high alkalinity of the bark ash, particularly the calcium and magnesium content, is cited as a reason for the results. Furthermore, the formation of SO_3 is sensitive to combustion temperature, and the higher combustion temperatures found in oil and coal combustion are more conducive to SO_3 formation (and consequently SAM formation) than for biomass combustion.

The boiler proposed for the project is of fluidized bed design, which inherently operates at lower combustion temperatures than other boiler designs. Also, the ash composition of the stillage fuel with respect to alkalinity is consistent with that found for bark and wood. Furthermore, the project proposes to employ SNCR as BACT for NO_X control, and the EPRI report notes that SNCR reduces SAM emissions. Consequently, one can conclude that SAM emissions from the proposed boiler will be less than that expected for fossil fuel combustion. Lastly, the boiler is very well controlled for SO_2 and SAM emissions; the limestone addition to the fluidized bed and the scrubber in the flue gas will provide both SO and SAM control.

For the purposes of illustrating the upper bound of SAM emissions for the project, one can assume that SAM emissions can be quantified as 4 percent of the SO_2 emissions from the boilers. As noted above, this would be representative of No. 6 fuel oil combustion which is not being considered for this project. The total potential SO_2 emissions from the boilers are 73.3 tpy. Using the conservative approach results in SAM emissions of 2.9 tpy. Even with such a conservative approach, SAM emissions would be less than the 7 tpy significance threshold for PSD and one can conclude that PSD requirements do not apply to SAM emissions. If one assumes natural gas combustion only, the SAM emissions would be estimated as 1.1 tpy based on EPRI's report. Based on NCASI's findings, SAM emissions will likely be less than 1.0 tpy.

Regards,

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