Novinda

Innovative Solutions for Industry

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Novinda Feed System Design to Accommodate a Range of Reagent Properties

Introduction

Novinda Corporation sells a non-carbon reagent for capture of vapor-phase mercury from the flue gas of coal-fired power plants. This material is an option for utilities to meet the EPA MATS requirement for stack mercury emissions that begins in April of 2015. Amended Silicates AS-HgX consists of a bentonite substrate that is amended with a metal sulfide that acts as the reagent to capture mercury from the flue gas as mercuric sulfide, the most stable form of mercury found in nature as the mineral metacinnabar.

To provide utilities the ability to feed a range of mercury capture agents Novinda (in conjunction with Jenike & Johanson, www.jenike.com) has developed a design that will feed two of the most popular mercury control reagents, Amended Silicates and Powdered Activated Carbon (PAC). Adopting this design enables utilities to feed both of these products as well as providing a system that will likely feed other materials (not yet envisioned) as well, thus avoiding future expense to modify the feed system[1].

Results

Jenike & Johanson measured a full set of flow properties for Amended Silicates and PAC. The parameters included: cohesive strength which allows for calculation of the minimum hopper outlet size to avoid a cohesive arch flow obstruction; wall friction which is used in the calculation of the required hopper angles to obtain mass flow whereby all the material is in motion if any is discharged; bulk density range that helps establish structural loads, feeder speeds and storage capacity; and permeability which allows calculation of critical steady solids flow rate from a mass flow hopper.

In aggregate the flow properties data established the important equipment flow features for the new feed system. First due to the performance requirements of the feed system and a wide disparity in properties between AS and PAC it is impractical to design one system that can feed both materials in unassisted gravity flow. Based on air-assisted discharge tests it is envisioned[2] that it is possible to utilize one design to feed both materials using an air-assisted discharger at the bottom of the hopper. A concept for the proposed feed system is provided in Figure 1 below.

The balance of the storage and feed system is similar to most bulk solids feed systems currently in use for PAC. Some key design features Novinda recommends are:

1. Solids metering can be performed utilizing loss in weight feeders in combination with either a dry air driven eductor or a rotary valve that feeds material into a flowing air stream. The rotary valve is favored for higher flow rates and pressure drops; the eductor system works well to deagglomerate particles and is best suited for low pressure drop situations.

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[1] The material flow properties of PAC vary widely depending on the supplier and process conditions. It is recommended that prior to using PAC or any other reagent in the system, the flow properties of a representative sample be measured to ensure the material will flow without problems in the system.

[2] Air-assisted discharge tests were performed on a sample of AS. Based on the flow properties of the PAC and anecdotal history handling PAC, it is assumed that air-assisted discharge is appropriate for PAC as well. Further testing is recommended to validate this assumption

2. Due to the abrasive nature of some particulate materials it is recommended that piping systems be configured such that sections wherein flow direction changes are augmented with ceramic lining to minimize wear.
3. Manifolds utilized to split flow to ducts and/or lance arrays utilize 'spider' manifolds that provide a gradual change in flow direction and that abrupt changes such as with a 'tee' are avoided.
4. Since AS is a dense material, ~50 lb/ft^3 (function of consolidating pressure) Novinda recommends a minimum transport velocity that maintains dilute phase flow to avoid particle saltation.

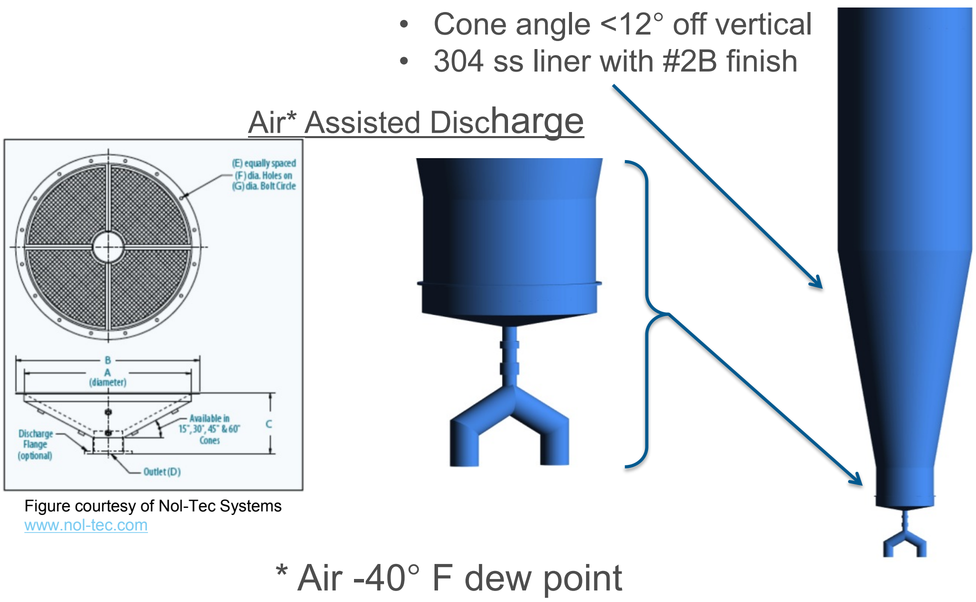

Figure 1 Flexible feed hopper design

The final elements in the reagent delivery system are the injection lances. Novinda recommends that lance spacing be guided via CFD modeling to establish the best location(s) for reagent injection. Typically lances are spaced no more than 30" apart. Further, multiple discharge points (spaced no more than 30" apart) are provided along the length of a lance assembly by running parallel pipes to different depths thus establishing an even distribution of material along the length of the lance. Turbulence, mixing and distribution are enhanced by placing a flat or angled baffle along the length of the lance on the upstream side of the assembly as shown below in Figure 2.

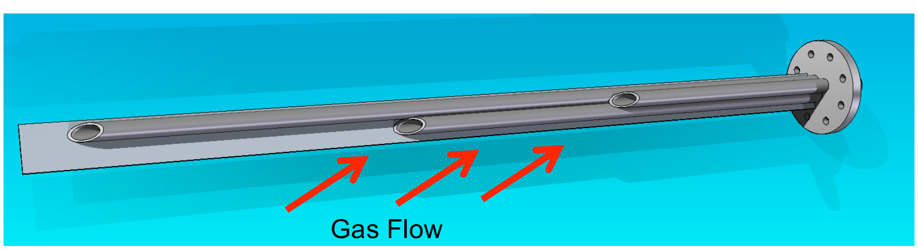

Figure 2 Lance conceptual design

Resources

Based on the design requirements set in collaboration with CH2M Hill and the work described above a complete specification for a system to feed AS and PAC was developed. The system specification is available from Novinda.

Novinda is now involved in multiple projects to convert systems originally designed to feed PAC to feed AS. Contact us for consultation on this and other requirements.

Further detailed information on Amended Silicates, Testing and Engineering Services is available to interested parties. Please contact Cliff Brown, VP of Applied Engineering c.brown@novinda.com or Steve Baloga, VP of Environmental Services s.baloga@novinda.com .