Impacts of Pressure Differentials between Flash Tanks on Flash Train Performance

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Abstract

The operational performance of a Bayer process digestion facility and the hence overall performance of an alumina refinery are significantly influenced by flash train design and performance. The mechanical and process design of a digestion facility must include the correct number of flash stages to match the range of operating conditions that are likely to be encountered. This will ensure the pressure differentials between flash tanks are within acceptable limits and the facility availability is high. This paper will review a number of digestion facility designs that accommodate maximum digestion temperatures across the range of 145 – 280°C. The design methodologies used to suppress the onset of three-phase flow between flash tanks (including both up-flow and down-flow designs) and the techniques used to minimise erosive wear will be discussed in detail. Finally, recommendations will be provided emphasising considerations that need to be understood when designing bauxite digestion facilities.

Keywords: Three-phase mixture velocity; wears; number of flash stages; pressure differentials.

1. Introduction

The design of a digestion multistage flash tanks and associated liquor or slurry heat exchangers must consider a number of important criteria, some of these are listed below.

- Minimise energy consumption.
- Maximise refinery productivity.
- Minimise and simplify maintenance requirements.

As the number of flash stages is increased, the amount of vapour evolved at each stage is less, but with an increased saturation temperature. Consequently, it is possible to use these smaller masses of higher grade vapour across an increased number of liquor/slurry heating stages to achieve a higher temperature prior the live steam heaters thereby reducing live steam consumption.

To identify the optimum number of flash tanks, designers must consider both capital and operating costs. A decrease in capital costs can’t be consumed by an increase in energy consumption and maintenance costs. The pressure differentials between flash tanks and the hydraulic ability of the flash train must provide the required level of mechanical availability for the range of operating conditions.

2. Considerations of Number of Flash Stages

The velocity of a three-phase mixture will increase in response to an increase in the pressure drop between flash tanks and/or in the slurry flow rate. When this occurs at the low pressure end of a high temperature mineral digestion facility, the velocity can become very high because the specific volume of vapour increases dramatically as pressure is reduced.