Testing and modelling of a coarse iron ore slurry for pipeline friction and pump head derate

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ABSTRACT

A 4-component model for settling slurry pipe flow has been previously described by Wilson and Sellgren to predict pipeline friction loss over a range of slurry compositions: from fine to coarse particle size, narrow to broad particle size distribution, and low to high solids concentration. The method applies a weighted average of established pipeline models for various settling slurry flow regimes, according to the volume fraction of solids falling within the applicable size range for each model. Further development of the model was undertaken by Visintainer et al. based on a comprehensive set of laboratory tests in 489 (20 inch), 203 mm (8 inch) and 103 mm (4 inch) pipelines, and was also adapted to the modelling of slurry pump performance derates. However, this work was all performed with solids having a specific gravity near 2.65, as is typical for many mineral processing and dredging applications.

The goal of the present work is to validate the applicability of these models for settling slurries having a higher solids specific gravity, as may often be seen in the mineral processing of iron ore deposits. To that end, a test program was carried out in a 103 mm (4 inch) pipe loop using a coarse iron ore product having a solids specific gravity of 4.78. This ore product is designed for ballasting applications and has a top size of 8 mm. By various screening and flushing operations during testing, a range of particle size distributions were created, each containing different proportions of the coarse and fine elements, and each being tested at various concentrations up to 35% by volume. Pipeline friction loss and pump performance data were collected and used to test the applicability of the previously developed 4-component models.