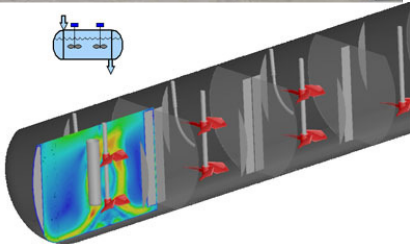


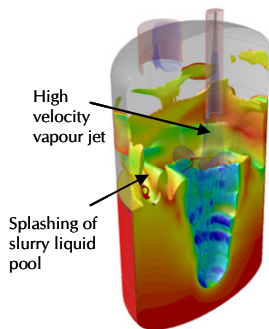
CFD MODELING OF SLURRY HANDLING SYSTEMS

Many metallurgical processes & ore treatment plants commonly involve slurry handling. Common equipment used includes: leach reactors, slurry heat exchangers, fluidized bed reactors, mixers, digester tanks, surge bins, gravity distributors, precipitators, launders, floatation cells, and slurry piping systems. The design of such systems requires a good understanding of the multiphase flow behaviour for the given operating conditions. For example:

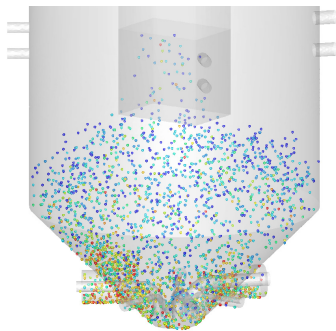
- Mixing, blending, solids suspension, gas dispersion, or residence time distribution in reactors and equipment handling slurries.
- Solids separation performance in clarifiers and thickeners.
- Heat transfer in slurry heat exchangers.
- Flow balance characteristics and solids segregation performance for multi-way gravity distributors and the surge bins
- Crystallization and solids segregation in precipitators
- Pipeline flow, pressure drop, and erosion characterization of slurry handling systems



Autoclave reactor flow mixing modeling



Flash vessel flow simulation for the prediction of jet penetration depth & slurry carry over behaviour



Assessment of the solids size distribution within an existing mineral sands surge bin [red = large dia, blue = small dia]

RATIONAL FOR COMPUTATIONAL FLUID DYNAMICS (CFD) MODELING

The multiphase modeling capability of CFD allows for the simulation of gas-liquid-solid interactions, including interphase mass & heat transfer, and chemical reactions. It allows for the visualization of internal fluid dynamics and phase characteristics, and provides an understanding of the influence of equipment internals or particular operating conditions on process performance. The simulation results typically provide following information:

- Three-dimensional distribution of velocity, pressure, phase, temperature & concentration profiles allowing to identify potential flow dead zones or hot spots
- Residence time distribution (RTD) of the feed based on stimulus-response tracer tracking method. This information can be used to evaluate the reactor performance in comparison of an ideal PFR or CSTR behaviour
- Solids suspension, segregation, and settling characteristics



SPECIALIZED ENGINEERING
ANALYSIS & DESIGN GROUP



CFD Model based volume fraction prediction of liquid-solid fluid bed reactor (red = solids, blue = liquid)

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CFD PROVIDES ANSWERS TO THE DIFFICULT QUESTIONS

The standard design practices, empirical methods, and rules of thumb are not sufficient to answer many of the questions necessary for an engineer to confidently design a slurry handling system. For example:

- Will there be any flow dead zones potentially resulting in hot-spots or undesired solids accumulation? Where?
- What will be the actual residence time of the feed?
- What extent the reactor will perform to as PFR or CSTR?
- Will there be any flow short-circuiting causing process inefficiency?
- What will be the influence of particular internals and its design?
- What will be the near wall velocities that can potentially cause excessive erosion?
- Will the solids be suspended well or there will be solids segregation?

SELECTED PROJECT AND EXPERIENCE LIST

BARRICK GOLD, PUEBLO VIEJO PROJECT, DOMINICAN REPUBLIC

Specialized analysis and multiphase flow modeling required during basic engineering to size pressure oxidation autoclave agitators and flash vessels to meet demanding process criteria. Autoclave trains are the worlds largest.

QMM ILMENITE, MADAGASCAR, SOUTH AFRICA

Multiphase CFD modeling of slurry flows inside the 3-way, 8-way and 9-way slurry distributors was completed to evaluate the flow distribution, slurry segregation and wall shear stresses for the given design with the purpose of ensuring the balanced flow distribution to the outlets keeping minimum wall erosion and slurry segregation.

RICHARDS BAY MINERALS, MSP TAILS TREAT. PROJECT, SOUTH AFRICA

Multiphase CFD modelling of slurry flows in surge bins, slurry preparation vessels and process water tanks involving nominal mineral sands solids content as high as 40%wt. has eliminated potential flaws in the designs and resulted in significant improvements in plant performance.

RIO TINTO IRON & TITANIUM INC, UGS EXPANSION PROJECT, CANADA

The liquid-solid fluid bed hydrodynamics was modeled to understand the acid and granular slag flow inside the acid leach reactor for the objective of optimizing the acid injection nozzle locations. The design was optimized for good contact between the injected acid & the slag thereby achieving improved reactor efficiency.

HATCH ADVANTAGE

The modeling analysis is performed by the Specialized Engineering Analysis & Design (SEAD) Group at HATCH. The team members have advanced level training and in-depth knowledge in the area of fluid mechanics and multiphase flow, and have been using analysis tools such as CFD modeling since the early 1990s to assist in the design of slurry handling systems. By combining the specialized expertise within this Group with the practical engineering know-how and experience at HATCH, a design optimized for performance, reliability, and safety is achieved.