Title of Product/Design/Equipment: Modelling and Simulation of Mineral and Material Processing Unit Operations

Application/Uses: Mathematical modelling and simulation helps in gaining insight and understanding of different complex phenomena. It is an important tool for process parameter optimization for improving performance as well as for better design of equipment using minimum material, energy and financial resources

Salient Technical Features including Competing Features: Development of first principle continuum models involving momentum, heat and mass transport (e.g. CFD), population balance model, as well as empirical models for process optimization of various mineral and material processing unit operations, such as, multiple hearth furnace, hydrocyclone, industrial scale fluidized bed roaster, liquid-liquid extraction column, spiral concentrator, magnetic separator, microfluidic devices etc.

Simulating flow of granular material using discrete element method (DEM), which is based on Newton's law of motion, taking into consideration collision between particles and tracking the motion of each particle in the system. Several mineral processing equipment have been simulated using DEM, such as, flow of granular material through hopper, segregation in a Jig, comminution in tumbling mills, mixing in rotating mixers etc. These studies help in optimizing the process parameters for maximizing the performance of the equipment.
Design of Experiment techniques, which minimizes the number of experiments to develop a working empirical model, such as neural network model, regression model etc., and use conventional as well as evolutionary (Genetic Algorithm) optimization techniques for process parameter optimization.

Molecular modelling, used for understanding the fundamental physics behind designing of novel materials for industrial processes. Molecular Mechanics along with Quantum Mechanical calculations has been used for selection of suitable extractants for separation of different metal ions from liquid solutions, as well as highly selective reagents for separation of useful minerals from undesirable minerals. Novel material for CO_2 sequestration as well as catalysts for industrial application can be designed using Quantum Mechanical models.

Level/Scale of Development:

Laboratory scale: Hydrcyclone, Spiral, Magnetic separator, Extraction column, Multiple Hearth Furnace, Hopper, Jig, Tumbling mill.

Industrial scale: Fluidized Bed roaster

Environmental Considerations: Pollution free as does not involve experiments

Technology Package: Modelling and simulation of various mineral and material processing unit operations

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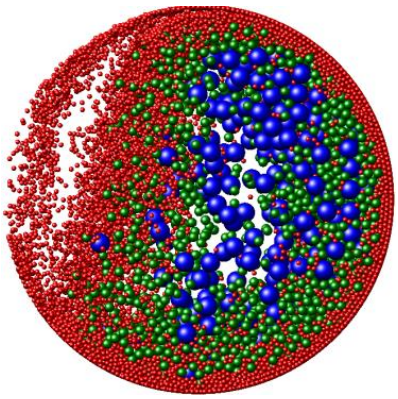
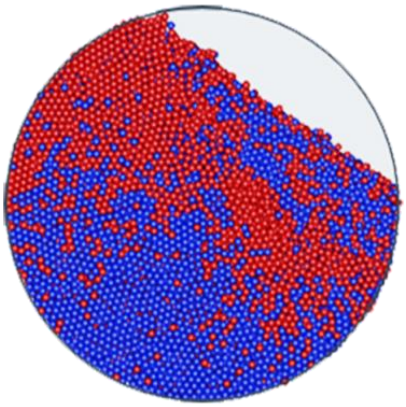
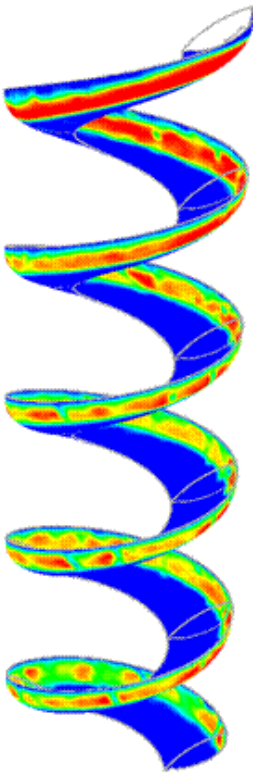
Figures:



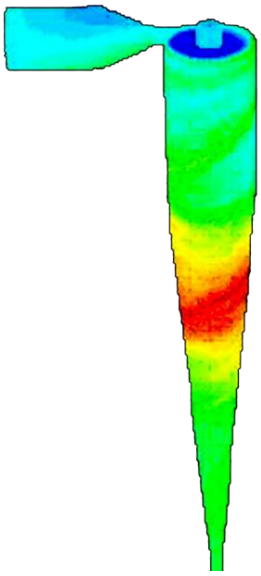
Segregation in a Tumbling Mill



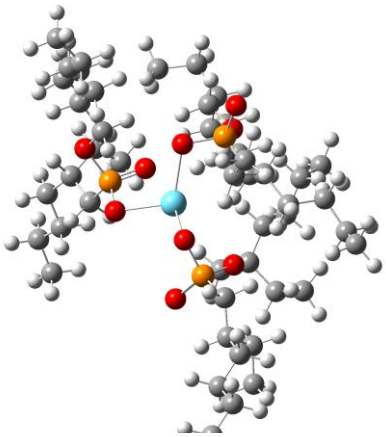
Mixing in a Drum Mixer



Flow of water on a Spiral



Solids flow in a Hydrocyclone



Structure of La Complex with PC88A