

The minerals industry is facing significant challenges driven by declining ore grades, increasing demand for industrial metals (particularly related to electrification of cars and renewable energy generation) and increasing pressure on the use of carbon based energy sources. All of these impact strongly on mineral processing and the unit operations that make up the grinding circuits that they use. Requirements to grind more material, to grind it finer, to grind rock with increasing amounts of gangue and with increasingly complex mineralogy will increase challenges in the development of new circuits and will require new comminution machines and machines that are better optimised. Conventional approaches for crusher and mill design and optimisation, which have been dominantly empirical, are very slow and expensive which strongly limits innovation. The Virtual Comminution Machine (VCM) is an approach involving a combined of detailed particle scale physics based modelling and laboratory characterisation of material behaviour particularly for breakage. The development of the VCM has been enabled by the substantial growth over the last two decades in compute power, the maturation of particle based modelling methods (and software) and increasing understanding of breakage fundamentals and how to characterise these. This talk will explore the VCM, its components and origins and the capabilities that it brings to understand the detailed mechanistic behaviour of particle breakage and particle and slurry transport. The use of such information for design of new machines, for testing of novel machine concepts (before even a physical prototype is constructed) and optimisation of existing machines will be discussed. The talk will showcase advanced full scale VCM models for several crushers and mills. The VCM is already being used to assess some novel comminution machines and to drive rapid design evolution. These developments are commercial in confidence.