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Improving the Design and Operational Efficiency of Mineral Processes using in-Situ Tomography

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Methods for achieving radical improvements to the separation and environmental efficiency of mineral processing rely upon availability of totally new treatment methods, incremental enhancements of existing processes and introduction of best practice in operation and control. This review paper describes examples of the utilisation of process tomographic methods to achieve these objectives, based on some case study examples relevant to coal, metallic and industrial minerals.

Process tomography involves the deployment of sensors that are normally mounted external to the process, from which signals can be gathered and used to derive information of dynamic and spatial changes within the process. For example, in some cases to produce a real time visualisation of changes in the concentration of materials within the process itself and quantitative measurements of vector velocity. These data provide invaluable insight into existing processing methods and can be used (a) to derive more accurate and advanced models for these processes, (b) to measure and audit actual process performance, and (c) utilised as part of control scheme, where warranted. Various sensing methods can be used for such purposes. This presentation will consider mostly the use of electrical impedance methods, since they provide rapid response and are suited to deployment at small (mm) and large (m) scales. In addition, some emerging work on microscale visualisation using focused x-ray methods will also be illustrated.

The paper considers five examples of process improvements derived from the advanced fundamental knowledge that tomographic analysis reveals:

- Velocity mapping in hydraulic transportation of slurries to minimise energy consumption and predict malfunction;
- Assurance of all time optimal operation of hydrocyclone separators treating mineral fines;
- Optimisation of oil-water separation in centrifugal separation of oil-contaminated water;
- Detection and tracking of blockages in powder flow hoppers;
- Scale-up of mineral slurry filtration design through bench top microtomographic measurement.

The future role of tomographic methods for mineral process model validation and, in some cases, plant monitoring will be highlighted.