See **inside** your process

Separation

Separation is crucial to the quality and yield of many industrial processed. Most measurement and sampling techniques observe the separation of two compounds in a narrow volume. This can lead to uncertainty and poor process efficiency. Process Tomography takes data through a volume and provides many data points, allowing users to more accurately manage separation processes.

Hydrocyclones

Electrical tomography can be used to investigate the performance of hydrocyclones. A tomography sensor fitted to the spigot of a hydrocyclone can measure the diameter of the air core. This helps to identify fault conditions and improve process performance. This example shows a sensor fitted to hydrocyclone at a clay mine and the relative performance of two spigots, which can be used to determine optimum operating pressure.

Key Benefits

- optimise performance through on-line measurement of air core diameter
- diagnose fault conditions
- visualise conditions within hydrocyclones

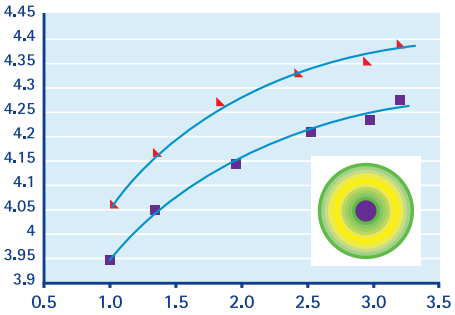

Figure 1: relative performance of two spigot types

Figure 2: Hydrocyclone

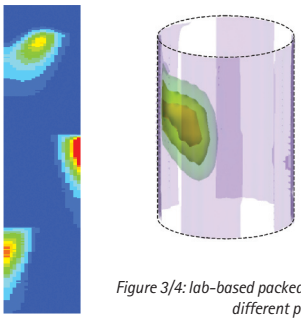

Figure 3/4: lab-based packed bed and spreading of brine pulses at different positions in packing.

Packed Beds

Tomography sensors fitted to a packed bed can be used to determine the nature of flow through cross sections. This information can help determine the quality of packing. This example shows a packed bed and the spreading of brine pulses at different positions in packing.

Key Benefits

- assess quality of packing
- shorten cycle times by measuring reaction conditions through bed
- increase yield by measuring phase concentration and boundaries
- measure flow velocities to identify areas of good and poor contact
- development of new distributor arrangements

Level Detection

Interfaces exist between two immiscible fluids and also between a liquid and foam or the solids component of a slurry; gel or soft solid and a liquid supernatant. If a visual or line of sight indicator is not feasible interfaces can often be very difficult to identify, particularly as single point measurements are usually at fixed positions and hence cannot cope with variable levels.

A process tomography probe can be used to measure the depth of different components in a vessel in real time. The benefits of a tomography probe are that it can be left in the process fluid without disturbing process conditions and is then able to scan across a wide range of depths. Probes are extremely robust and able to withstand challenging temperatures, pressures, chemicals and high radiation fields.

Key Benefits

- identify boundaries between gas/liquid; liquid/liquid; solid/liquid; liquid/foam; emulsion and water/organic phase
- measurements not dependent on hard interfaces, transparency or density differences
- non-intrusive probes, able to scan through process fluid
- monitor solid suspension times

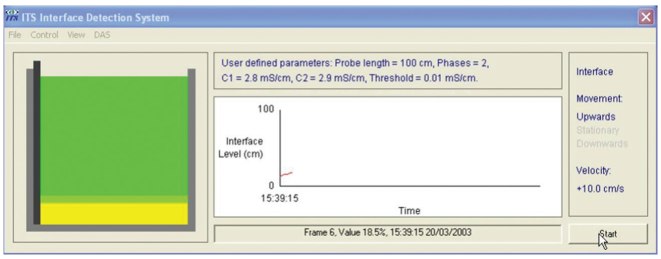

Figure 5: Interface detection display

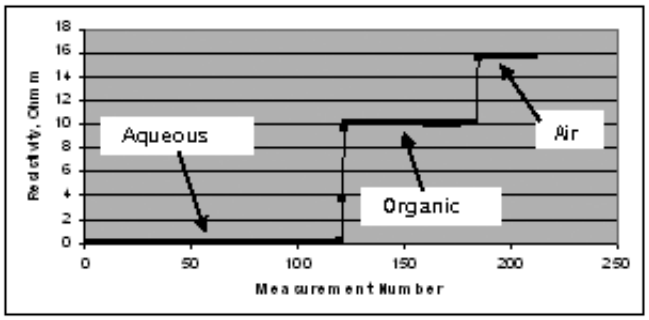

Figure 6: Interfaces between different materials flowing through sensor

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See **inside** your process

Case Study: Pressure Filtration

The Challenge

In most pressure filters a significant problem is that they do not have the instrumentation to help an operator judge, for instance, whether the filter cake has "rat holes" or whether wet patches remain. As a result, the determination of the end-point can be very hit and miss. Operators can find themselves pressurising batches first during filtration and then during washing and drying for long hours, spending – and almost certainly wasting – precious time and energy. If one batch takes 100 hours instead of 50 hours, the integrity of batches following on behind and the planning of asset use can be compromised.

The Solution

Electrical Resistance Tomography (ERT) visualizes the contents of vessels and pipelines containing multi-phase mixtures without disturbing the flow. In the context of pressure filtration – and this is but one of many potential process applications – it lets the filter operator see what is going on inside the filter cake. The information produced is graphic.

For instance, a typical conductivity read-out against time illustrates filtration and four washing cycles followed by drying. Armed with the information that ERT supplies, the operator can make changes to process conditions and watch as filtration performance improves.

ERT results were tested against several factors often used to judge the progress of pressure filtration, such as the variations of level, pressure, load on the agitator and air temperature in and out.

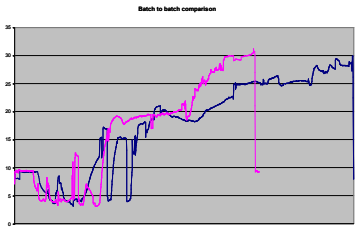

Figure 2: Batch to batch comparison

The graph above shows how the mean of over 100 different voltage measurements through the filter cake varies with level over time. The various wash cycles are indicated by step increases and decreases in voltage during the early stages of each batch, and the drying cycle by a steady increase in voltage. ERT and level data match well. As each data point on these trends is a mean of the 100 or so individual voltage measurements taken from different regions within the filter, the data sets are amenable to statistical analysis.

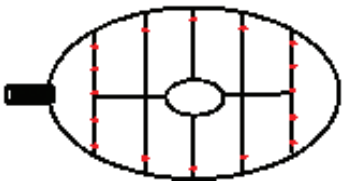

Figure 3: Filter cake structure fitted with 16 electrodes on hold down bars

Figure 4: Filter-Dryer

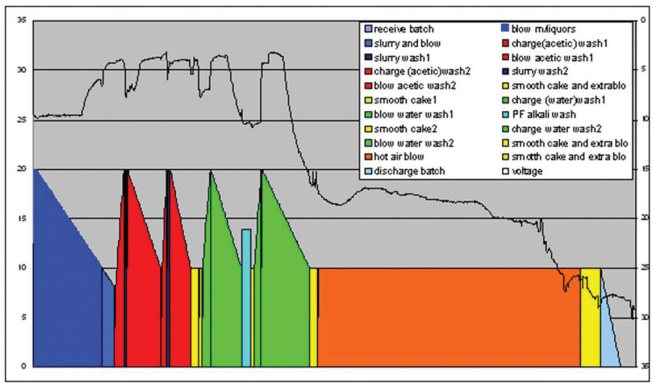

Figure 1: Process cycle vs tomography signal

Sampling strategies can also be validated. A tomographic image of the conductivity distribution through a horizontal section of a pressure filter shows that the area below the feed pipe has a higher moisture content (the red area at one o'clock) than elsewhere. In order to determine level of dryness (LOD) of the filter cake, the sample point may be located in the area under the feed pipe. The images (Figure 5) during drying gives a clear indication of which sections of the cake are dry and which still wet.

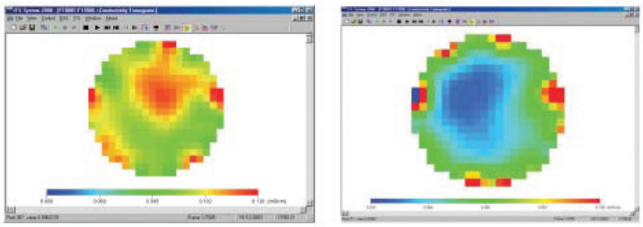

Figure 5: ERT tomograms showing dry (blue) and wet zones (red)

Customer Benefits

- Improve yield and quality
- Reduce use of raw materials & capital cost
- Operate more safely with less sampling
- Characterise variation of drying of filter cakes
- Determine structures in filter cakes (cracks/rat holes)
- Determine bulk level liquor– liquid level detection

References

Bolton, Hooper, Mann and Stitt (2004) Flow distribution and velocity measurement in a radial flow fixed bed reactor using electrical resistance tomography, Chemical Engineering Science, Vol. 59, No. 10, pp 1989-1997

Bennett, M.A. and Williams, R.A. (2004) Monitoring the operation of an oil/water separator using impedance tomography, Minerals Engineering, Vol. 17, No. 5, pp 605-614

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