Electrical process tomography for monitoring selected mixing processes in the pulp and paper and mineral industries

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KEY WORDS: electrical resistance tomography, pulp and paper, mineral industry, tomography

INTRODUCTION

Mixing is one of the basic processes in many industrial fields. The quality of mixing greatly affects the process outputs and end products. For the process industry, improved mixing means increased process efficiency, sustainability and competitiveness. Common features for mixing phenomena are that they are relatively fast, mixed process materials are usually opaque, and mixing is a volumetric process.

Information of the behavior of industrial mixing processes is usually obtained by offline laboratory tests, in situ measurements, or computational fluid dynamic (CFD) simulations. The typical requirements for online measurement methods of mixing processes are that they have to be non-invasive and fast enough with respect to the process time constants. The third requirement is that the measurement method is capable of producing information about the whole mixing volume. However, current techniques are usually point-wise measurements; this means that they only give local information about the mixing performance. Therefore, there is a need for new measurement techniques, which meet all the earlier mentioned requirements.

This paper is based on mainly the work presented in dissertation: "Imaging of mixing in selected industrial processes using electrical resistance tomography" by Jari Kourunen 2014 and presents the latest developments within minerals process industry. This is done by studying the feasibility of Electrical Resistance Tomography (ERT) for monitoring different types of mixing processes in the pulp and paper and mineral industries. ERT is an

imaging method in which alternating electrical currents and measured voltages from the boundary of the object are used in the estimation of the real valued conductivity distribution within the object, see Figure 1.

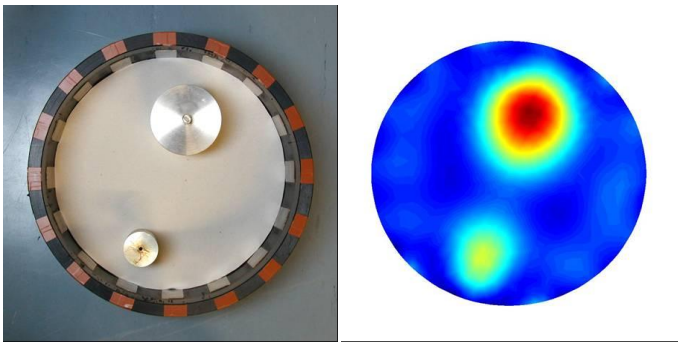

Figure 1. Physical setup where two electrically conductive objects are placed inside a ring of electrodes (left), and the resulting conductivity distribution based on ERT calculations (right).

The ERT system was used for monitoring the mixing in a turbulent flow with two different type of mixing devices designed to inject papermaking chemicals and additives. ERT was also used to study mixing phenomena in a medium-consistency (MC) mixer in the pulp industry see Figure 2. Finally, in order to get information on the applicability within minerals industry, ERT technique was used to characterize the three-dimensional gas holdup distribution in a mechanical flotation cell.

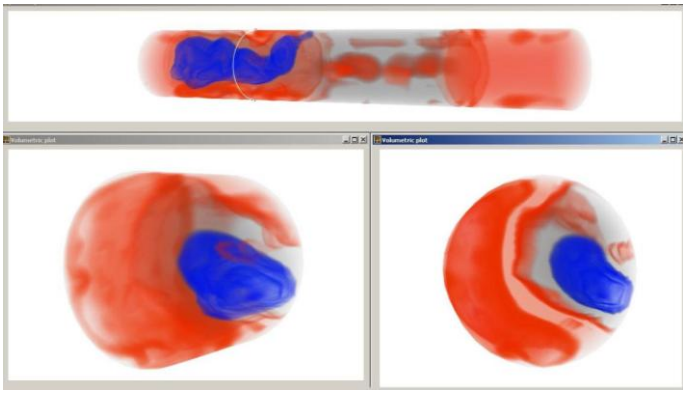

Figure 2: A timeline representation (up) and two snapshots (down) from the MC-mixer study. Down left: A 3D representation of the conductivity distribution. Down right: A 2D slice of the conductivity distribution.

The results show that the chosen mixing processes can be studied successfully with ERT technology. The tomographic methods can be used in design and optimization of mixing devices in the mineral and pulp and paper industries. Therefore, Outotec (Finland) Oy has developed tomography based LevelSense™ and SandSense measurement devices for froth flotation and OKTOP® reactors, where the physical arrangement of the measurement electrodes is different from the one described above. In addition to these, new applications are sought actively by Outotec (Finland) Oy.

2 REFERENCES

Kourunen, J.: Imaging of mixing in selected industirial processes using electrical resistance tomography, PhD Thesis, University of Eastern Finland, Kuopio, Finland, 2014.