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Quantitative Tomographic Measurements of Opaque Multiphase Flows

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Quantitative Tomographic Measurements of Opaque Multiphase Flows

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Abstract

An electrical-impedance tomography (EIT) system has been developed for quantitative measurements of radial phase distribution profiles in two-phase and three-phase vertical column flows. The EIT system is described along with the computer algorithm used for reconstructing phase volume fraction profiles. EIT measurements were validated by comparison with a gamma-densitometry tomography (GDT) system. The EIT system was used to accurately measure average solid volume fractions up to 0.05 in solid-liquid flows, and radial gas volume fraction profiles in gas-liquid flows with gas volume fractions up to 0.15. In both flows, average phase volume fractions and radial volume fraction profiles from GDT and EIT were in good agreement. A minor modification to the formula used to relate conductivity data to phase volume fractions was found to improve agreement between the methods. GDT and EIT were then applied together to simultaneously measure the solid, liquid, and gas radial distributions within several vertical three-phase flows. For average solid volume fractions up to 0.30, the gas distribution for each gas flow rate was approximately independent of the amount of solids in the column. Measurements made with this EIT system demonstrate that EIT may be used successfully for noninvasive, quantitative measurements of dispersed multiphase flows.

Acknowledgments

The authors wish to thank the following individuals for their assistance and interactions. Dr. Bernard A. Toseland of Air Products and Chemicals, Inc. provided useful guidance and information about industrial-scale bubble columns. A portion of this work was funded by the Federal Energy Technology Center under Field Work Proposal FEW 8616. Thanks go to Dr. Ann Tassin Leger, formerly of the University of Michigan, for her assembly and testing of the original version of the Sandia/Michigan EIT system and Dr. Douglas R. Adkins for his early work with the GDT system. Prof. Milorad P. Dudukovic of Washington University in St. Louis is acknowledged for his advice on the development of validation testbeds for multiphase flows. The authors also wish to thank the technical staff at Sandia whose expertise kept the EIT validation studies moving forward: C. "Buddy" Lafferty, Tom Grasser, Jaime Castañeda, John O'Hare, "Rocky" Erven, and W. Craig Ginn. Dr. Arthur C. Ratzel of Sandia National Laboratories is thanked for his management and support of this research.

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