

High-Intensity Piezo-Ceramic Ultrasonic Transducer with Mechanical Amplifier and Radiation Plate

A. van Wijhe¹, W. de Jong¹

¹Process & Energy, 3mE, TU Delft, The Netherlands

Abstract

Introduction

A COMSOL Multiphysics® model was made to design a mechanical amplifier and radiation plate for the emission of high intensity 40.5 kHz ultrasound to air by means of a Langevin type transducer usually applied in cleaning baths for example. In this work, ultrasonic irradiation is aimed at acting on flue gas containing fine particulate matter to realize a shift to higher effective particle sizes as a result of induced particle agglomeration.

A commercially available Langevin type Bolt-Clamped ultrasonic transducer has been taken apart, measured, and modeled using COMSOL Multiphysics®. The simulation results were verified by laser Doppler velocimetry (Figure 2). After that a solid horn and radiation plate were designed to generate a maximum amplitude of radiation at the desired frequency. The horn and plate were fabricated and tested again with the Laser Doppler velocimeter (figure 3).

Results

The COMSOL Multiphysics® model simulations resulted in a quite accurate prediction of the resonance frequency and mode shape up to 70kHz (higher frequencies may cause mode shapes which are not axi-symmetric and are not relevant for this work). (Figure 2 & 3). The amplitude of this resonance depends on factors including the material damping and is fitted to experimental results using the Isotropic loss factor.

Acknowledgment: The Measurements with the Laser Doppler Vibrometer are done at the Precision and Micro Engineering department of 3mE, TU Delft.

Reference

Juan A. Gallego-Juárez et al, A macrosonic system for industrial processing, Ultrasonics 38, 331-336 (2000)

Vladimir N. Khmelev et al, Designing and Efficiency Analysis of Half- Wave Piezoelectric Ultrasonic Oscillatory Systems, 6th INTERNATIONAL SIBERIAN WORKSHOP AND TUTORIAL EDM 2005, SESSION II, JULY 1-5

Juan A. Gallego-Juárez et al, An ultrasonic transducer for high power applications in gases, Ultrasonics 16, 267-271 (1978)

Figures used in the abstract

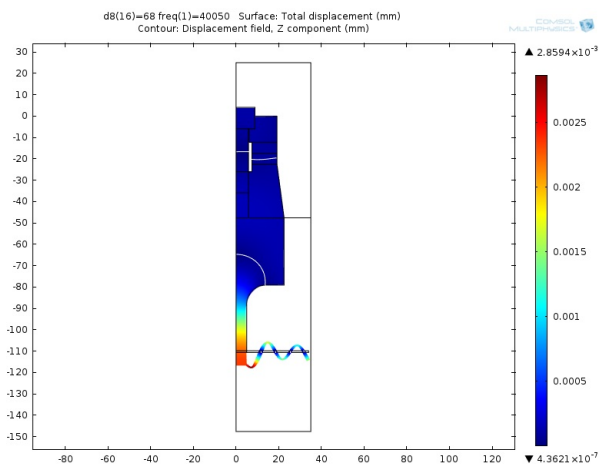


Figure 1: comsol mode shape

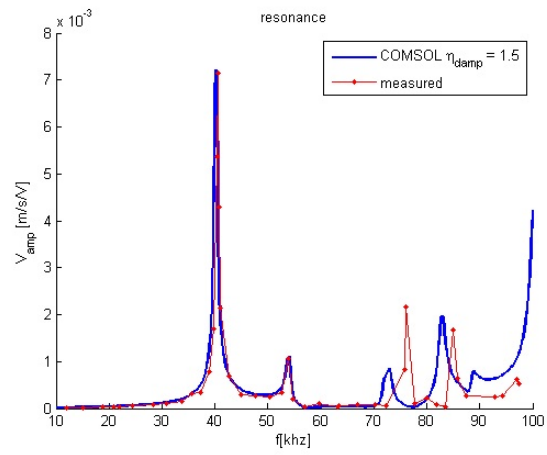


Figure 2: frequency response model/measured

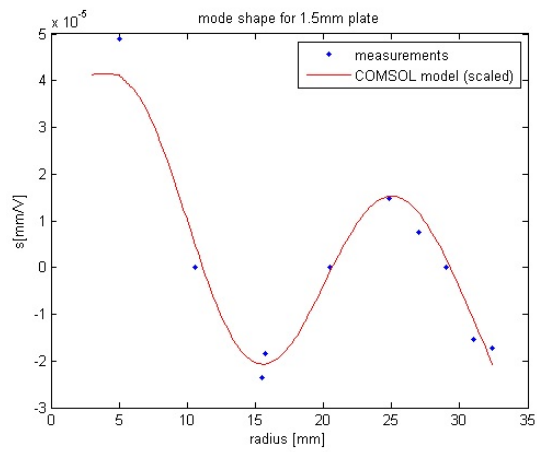


Figure 3: mode shape comparison

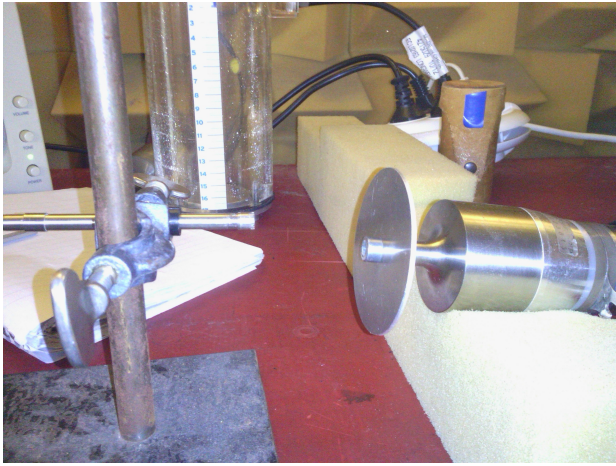


Figure 4: SPL measurement