Design of Experiments: Creation of a Piezoelectric Speaker

Gregory Graf¹ and Karla Mossi²

¹ Mechanical Engineer Junior, Virginia Commonwealth University

² Assistant Professor, Virginia Commonwealth University

Research Purpose

- Poly-vinylidene fluoride (PVDF) is a polymer that exhibits a piezoelectric effect, in that the material deforms under application of an electrical voltage (or vice versa.)
- While the movement of a sheet of PVDF is so small as to be invisible, it is significant enough to produce pressure waves, detectable as sound.
- If this effect can be developed, an extremely simple speaker can be produced.
- This speaker would have an advantage compared to standard magnetic coil speakers, as its few moving parts would protect against dust contamination and the chemical properties of PVDF would resist many types of corrosion.



Experimental setup with the 10cm cavity





The three cavities used during experimentation. From left to right: 10cm, 20cm, 30cm radii.



Tektronix TDS 210 Digital

Real-Time Oscilloscope

Radio Shack Sound Level Meter

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Hewlett Packard 33120A

Signal Generator

Results and Conclusions

Cavity	52 Microns A	52 Microns B	28 Microns A	28 Microns B
30cm	76	79	79	78
20cm	85	89	84	81
10cm	88	89	90	88











□A simple, yet effective, piezoelectric speaker can be constructed.

Different cavity radii and film thickness caused the peak sound level to increase as much as 13 db (an increase of 16%.), and 5db respectively.

This suggests a high dependence on radius, and little or no dependence on film thickness.

The frequency at which the maximum sound level occurred had significant changes that resulted from both the cavity, and the film thickness. A two-way ANOVA, an analysis method that determines whether there is a 95% confidence level that the dependent variable affects the independent variable, verified these observations.

While there was not enough data for statistical calculations, qualitative analysis showed that rotating the film 90 degrees increased the peak sound level by as much as 9db to a maximum peak of 97db, while insulating the cavity clearly smoothed discontinuities in the sound level plot.





Example of smoothing provided by cavity insulation

Variation in sound level due to cavity radius