Lab 10

Introduction/Background

This lab gave us a great demonstration of measuring dielectric constants. David used a coaxial probe which is basically just a simple open-ended section of coaxial cable. Fields from the open circuit fringe into the material and we use reflection data to characterize ε_r . The dielectric constant is the relative permittivity of a dielectric material. It is very beneficial in characterizing capacitors. The relative permittivity is also defined as the factor by which the electric field between the charges is decreased relative to a vacuum.

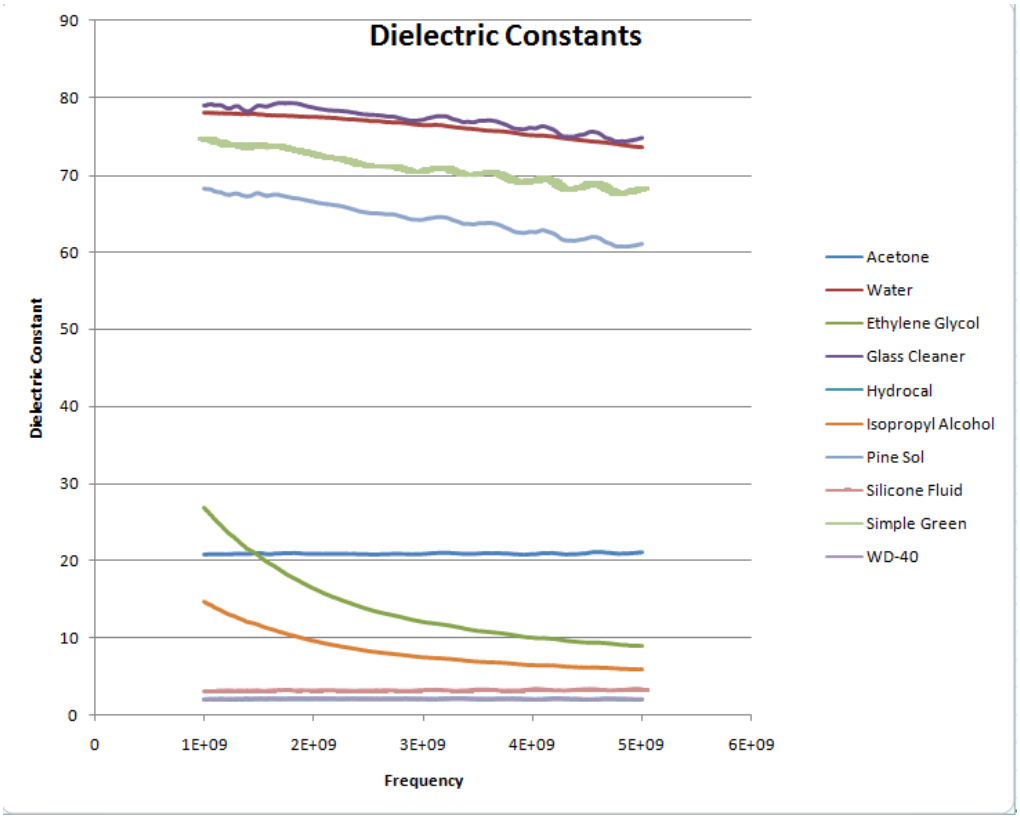
Design

There was no design stage for this lab.

In Lab Procedure

In lab David measured the dielectric constants of 10 materials using the coaxial probe discussed in the introduction. He first had to calibrate the probe by measuring air, short, and water. Water has the highest dielectric constant, so we were able to compare how much smaller the other materials' dielectric constants were. The probe had to be re-calibrated between each material. The graph below shows a super-imposed version of the data collected in lab.

Results and Discussion



Conclusion

The main points of this lab were to prove the fact that water has the highest dielectric constant, as discussed in class, and to show us a reliable way to measure the dielectric constant of liquids.

We used DI water because it does not have extra ions that would affect the probe when calibrating. Water that is less pure, like tap water, would have these ions which would make later measurements less accurate. The only way we can think to improve the calibration process would be to have the software remove any outlier values in the initial calibration. These outliers tend to swing all further data in one direction and make them slightly less accurate.

Open-ended elliptical coaxial probes can be used in wideband dielectric constant measurements as well as narrowband. The dielectric constants of liquids are measuring the ability of a substance to store electrical energy in an electric field; so we can generalize the liquids that are good at storing energy like water and glass cleaner, versus the ones that are not good at storing energy like silicon fluid and WD-40. Glass cleaner and Simple Green were considered "watered down" because they had dielectric constants closest to water.

Hindsight

We realized that we should have brought some liquids to measure so that there would be more materials to compare to water.

Reflection

There really wasn't a challenging part of this lab because there was no design and the in-class portion was done completely by David.

The most rewarding part of the lab was getting to see how the dielectric constants of some common liquids compared to that of water.