CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

S0917

Project Title

The Effects of Temperature and Relative Humidity on the Path Taken by an Electric Arc Generated by a Tesla Coil

Abstract

Objectives/Goals

Electric arcs have found much fame for their chaotic and unpredictable behavior. The purpose of this experiment was to determine if properties of the air, such as temperature and relative humidity, had any influence in the behavior of electric arcs. It was hypothesized that both factors would be correlated with arc behavior in some form.

Methods/Materials

A Tesla Coil was used as the electric arc generator. A plant growth chamber capable of controlling both temperature and humidity to a high degree of accuracy was used as the vessel for the experiment. Data would consist of pictures of arcs taken from two different angles. One camera rig had the camera look down vertically upon the arc, and another rig had the camera look horizontally at the arc. These pictures were then process through Microsoft Paint. Maximum deflections of the arcs from an ideal path of the arc were collected, as were areas bounded between the arc and the ideal path. Statistical analysis on this data was then done through Microsoft Excel.

Results

It was found that temperature had a very strong correlation with arc movement within the x-axis of motion (horizontal deflection). As temperature increased, the arc tended to move straighter, closer to the ideal path. Relative Humidity was found to have no significant correlation with arc movement within the x-axis of motion. Within the z-axis of motion (vertical deflections), neither temperature nor humidity were found to have correlations with arc deflection.

Conclusions/Discussion

Overall, the results of the experiment show a much less chaotic picture of arc behavior. No previous studies on the effects of environmental factors on electric arc behavior have been done. This study represents a step forward in the field. The implications of the study are that arcs are predictable phenomena, and that they can be controlled through the manipulation of the air. This opens the future possibility of controlled lightning, or at least predictable lightning. Controlled lightning could be used as a tool to power the world; predicting where lightning would strike would save lives by identifying areas in danger of a lightning strike. Future studies would focus on creating statistical distributions to account for the variances of arc behavior within a data set and on manipulating the arc to strike specific targets through the manipulation of air.

Summary Statement

This project determined the previously unknown effects of relative humidity and temperature on deflections of electric arcs from their ideal paths.

Help Received

Professor Randy Harris and Professor Cort Anastasio of UC Davis assisted in the data analysis portion of the experiment. Mr. Dennis Lewis of the UC Davis Controlled Environment provided the climate chambers used for the experiment.