Hygro-Electricity

A Possible Source for Renewable Energy in High Relative Humidity Zones

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Abstract:

Since the days of Benjamin Franklin (1752) we know the atmosphere and thunderstorms are electrified. However, even today we still do not know exactly how thunderstorms become electrified, although we do know that the key ingredient is the interaction between water molecules in their different phases (vapor, liquid and ice). Furthermore, the famous physicist Michael Faraday (1843) showed how electricity was produced by the friction of water droplets with metal surfaces.

Based on our knowledge of electrification during phase changes occurring in clouds, we will investigate the generation of electricity during the condensation of water droplets on metal surfaces, and asses its global potential in various spatio-temporal scales.

Following a recent study, experiments show that some metals can acquire spontaneous charge build-up, when exposed to high Relative Humidity (RH) conditions (>50%). Different metals charge with different polarity, due to water ions (OH- & H+) selective adsorption, according to the metal characteristics. Using two

different metals leads to voltage accumulation, acting as a capacitor, reaching 0.8V - half the voltage of an AA battery.

Our research mission includes 4 main stages: First, after reproducing the initial experiments of charge build up on metals, we now investigate how to increase the efficiency of the asymmetrical capacitor by further examination of different metals performance and physical characteristics in the lab. Second, we will carry out experiments in natural outdoor conditions. We will investigate the RH threshold needed for electricity generation, together with other factors, such as diurnal and daily fluctuations of RH, wind, aerosols, pollutant concentrations, etc., to determine which conditions would be needed and are optimal for generating outdoor electricity. Third, we will analyze the climatology of the most populated cities in the world, focusing on identifying potential locations for this technology. Finally, fourth we will develop a prototype battery that runs solely on humidity.

Our initial results confirm that charge is built up under high RH conditions, while different types of stainless steel (SS) reached an electrical potential of -0.9V, -0.8V and +0.7V. In addition, as long as we keep the high RH conditions – the voltage on the metals remain high. Other metals, such as aluminum and copper, accumulated relatively small electrical potential and some metals do not acquire charge at all. If alternative energy can be produced by the condensation of water droplets, we have an opportunity to develop a new innovative renewable source of energy that will be most useful in regions of high RH.