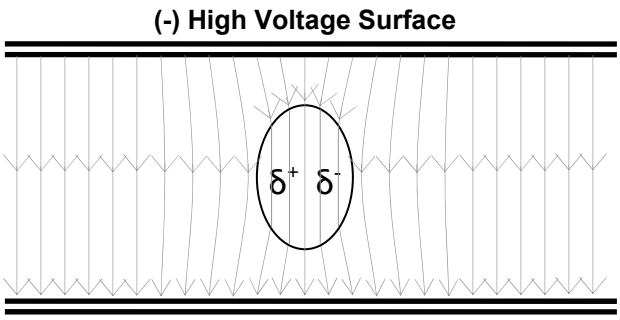
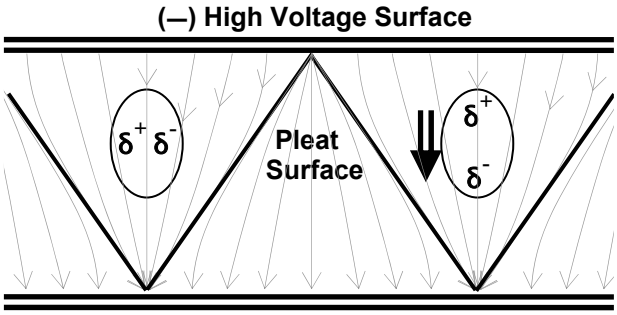
The Removal of Charge-Neutral Particles by the Principle of Dielectrophoresis

Electrophoresis and Dielectrophoresis

Electrophoresis, the phenomenon of a charged particle being drawn to an oppositely charged surface, is fairly easy and intuitive to understand. Dielectrophoresis is more complicated. The fluid and particle properties involved are the dielectric constants for the particle and the fluid (example, lubricating oil), the size of the particle and the gradient of the voltage field (representing the degree of non-uniformity of the field).



UNIFORM VOLTAGE FIELD



NON-UNIFORM FIELD

The strength of the dielectrophoretic (DEP) force depends on the degree to which the non-uniform voltage field polarizes the particle's charge distribution. In the graphic at left, the uniform voltage field shown acts symmetrically across the particle, resulting in no net movement of charge distribution and hence little or no DEP force. The voltage field shown in the bottom graphic has been distorted by the presence of a pleated surface having pointed edges that concentrate the field at the sharp edges and thus create a non-uniform field. The light lines running from the high voltage surface to the grounded surface shown in both graphics represent field flux lines. The best way to understand their significance is to consider them as behaving like light beams from flashlights, which when acting close together create a brighter light (more force), but when acting away from one another create a less intense combined beam. Where the flux lines are close together the field is strong and where apart, weaker.

The particle shown on the right in the bottom graphic is either highly polar by nature or has been made more polar by the non-uniform field and will move toward the greater field strength. The particle to the left is not charged nor significantly polarized and will consequently not be affected by the voltage field and removed by the Kleentek system.

Since oil molecules are not discrete particles but act as the fluid medium, they are unaffected by the field force. The strength of the dielectrophoretic force depends on the cube of the radius (R) of the particle, so oil additives are not affected due to their small size.

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