

Curiosity during flowing out of liquid from a metal pipe

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The plant engineer of a producer of hydraulic oils reported about the following curiosity with the request of comment and to find a remedy:

At a filling equipment for hydraulic oil already used for some time, a metal filter was incorporated to improve the quality. From that time on the liquid flowing out would rise at the vertical pipe end several centimeters, causing »sparks« there. However, this did not seem to be an imminent threat (flashpoint of the oil above 100 °C) but it confused the workers.

»Electrostatics« could have caused the climbing of the oil. So G. + S. Lüttgens, went there and what they got to see was very impressive (picture).

In fact, the liquid crept upward along the outside of the pipe, initiating gas discharges, accompanied by strong radio signals.

When approaching a needlepoint electrode towards the pipe's opening a corona current of 2.5 μA was determined and the appearances of gas discharges were diminished. This gave proof of electrostatic effects.

One possible explanation:

By flowing through the metal pipe the hydraulic oil will be electrostatically charged as it has a low conductivity (between 10 and 30 pS/m).

Caused by the installation of the filter consisting of a closely-meshed metal braiding, electrostatic charge increased considerably resulting in a highly negatively charged liquid at the open end of the pipe.

As the earthed metal pipe constitutes the closest counter charge for the charged liquid (electric induction), molecules close to the wall (flow speed near zero) will be attracted there and caused to stick at the open end of the pipe. However, they are forced to give way to the following charged liquid molecules and move against gravity upside at the outside of the pipe's end.

According to overcoming repelling Coulomb forces high charge density will result, bringing up propagating brush discharges as far as the dielectric strength of the liquid film is sufficiently high. This phenomenon was discussed with electrostatic experts

(DECHEMA) who in principle gave their consent with the given explanation. To eliminate those effects corona needle points were applied to the open end of the filling pipe.

In fact, by applying earthed needle points to the open end of the filling pipe the uprising of the liquid could be prevented. Even the presumably strong radio signals caused by propagating brush discharges no longer appeared. Instead some »crackling« could be perceived, most likely caused by strong corona discharges.

An electrostatic curiosity has been depicted which seems worthy to be reported about.