

Degradation of Power Contacts in Industrial Atmosphere: Silver Corrosion and Whisker

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Abstract - Degradation of power contacts in corrosive atmosphere leads to significant increase of the contact resistance and consequently to a rise in temperature, and eventually to the failure. In electrical apparatus, both base metal copper and silver plating heavily corrode in environment containing sulfuric gases. In addition, expansive growth of silver filaments (whiskers) has been often found on primary current conductors of circuit breakers. This paper describes extensive whisker growth found in switchgear at paper recycling mill. The major environmental factor to initiate the growth is relatively low concentration of Hydrogen Sulfide (H_2S). As soon as a thick enough layer of silver sulfide has been formed, metal filaments start to grow virtually everywhere but most intensely in locations usually having elevated temperature while electrical units are energized. Though hazardous phenomenon has been seen from 1920s and caused a number of violent failures, but it was practically neither studied nor understood. Just in two months after previous cleaning, we found the filaments up to several inches (6-8 cm) long and up to 0.04 in (1 mm) thick. Using SEM/EDS analysis we have determined chemical composition and morphology of the whiskers. Most of the whiskers are made of silver with 1-3 % of copper. The surface of the whiskers long exposed to atmosphere is contaminated with silver sulfide. After thoroughly investigating the factors that initiate and accelerate whiskers' growth we have determined effective means eliminating extremely hazardous phenomenon.