# Impact of Aging on the Electrical Strength of Different Pipeline Coating Materials

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**Abstract** With the continuous rise in energy demand, pipelines will play an indispensable role as the primary transportation medium for oil and gas resources for a long time to come. However, the complexity of the pipeline operating environment makes corrosion prevention a top priority for ensuring pipeline safety. As a primary external anti-corrosion layer for pipelines, three-layer polyethylene (3PE) experiences aging during long-term service, which weakens its corrosion resistance. This article examines the variations in electrical strength of three-layer polyethylene (3PE) and epoxy powder coatings (FBE) under dry and humid heat aging conditions. The experimental findings reveal that aging markedly decreases the electrical strength of both 3PE and FBE, with humid heat aging proving to be more detrimental to the materials. Additionally, infrared spectroscopy analysis shows that the aging process has a minimal impact on chemical groups such as epoxy rings and carbonyls in FBE. In contrast, aging has a pronounced effect on the structure and properties of 3PE materials. Coating thickness has a significant impact on the electrical strength of FBE; with increasing epoxy layer thickness, the electrical strength progressively diminishes. The decline is more gradual within the thickness range of 450 to 550 μm. This research provides valuable insights for the design and development of anti-corrosion coatings for pipelines. It holds significant implications for maintaining the safety of long-term pipeline operations in complex environments.

**Keywords** Internal coating, electrochemistry, hydrogen permeation, hydrogen resistance

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