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An Investigation of Brittle Fracture of Composite Insulator Rods in an Acid Environment with Either Static or Cyclic Loading

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Abstract

The effect of static and cyclic loading conditions on the stress corrosion cracking of unidirectional glass reinforced polymer (GRP) rods used in composite high voltage insulator has been investigated. A series of stress corrosion experiments have been performed on unidirectional E-glass/modified polyester composite rods. The rods have been subjected to mechanical tensile static and cyclic stresses in the presence of a nitric acid solution. The stress corrosion fracture process in the rods was monitored using acoustic emission techniques. The experimental loading conditions simulated possible in-service loads for composite suspension insulators. The results obtained in this study showed that the brittle fracture process can be generated in the rods when subjected to relatively low tensile stresses in the presence of a nitric acid solution. The morphology of the experimentally generated brittle fracture cracks in the rods closely resemble those from in-service failed composite suspension. It has also been shown in this research that low frequency, low amplitude vibrations in tensile loads can significantly accelerate the fracture process. It appears that the brittle fracture cracks in the rods generated under cyclic loads are less planar in nature in comparison with the cracks formed under static conditions. It has also been found that the acoustic emission generated during the stress corrosion fracture process in the rods is sensitive to the placement of the transducers. However, reasonably good correlation between the stress corrosion crack growth rates and acoustic emission has been attained.