

Development of graphene oxide-based nonedible cottonseed nanofluids for power transformers

ABSTRACT

Sustainable materials, such as vegetable oils, have become an effective alternative for liquid dielectrics in power transformers. However, currently available vegetable oils for transformer application are extracted from edible products with a negative impact on food supply. So, it is proposed in this study to develop cottonseed oil (CSO) as an electrical insulating material and cooling medium in transformers. This development is performed in two stages. The first stage is to treat CSO with tertiary butylhydroquinone (TBHQ) antioxidants in order to enhance its oxidation stability. The second and most important stage is to use the promising graphene oxide (GO) nanosheets to enhance the dielectric and thermal properties of such oil through synthesizing GO-based CSO nanofluids. Sodium dodecyl sulfate (SDS) surfactant was used as surfactant for GO nanosheets. The nanofluid synthesis process followed the two-step method. Proper characterization of GO nanosheets and prepared nanofluids was performed using various techniques to validate the structure of GO nanosheets and their stability into the prepared nanofluids. The considered weight percentages of GO nanosheets into CSO are 0.01, 0.02, 0.03 and 0.05. Dielectric and thermal properties were comprehensively evaluated. Through these evaluations, the proper weight percentage of GO nanosheets was adopted and the corresponding physical mechanisms were discussed.

Keyword: Transformer oil; Nanofluid; graphene oxide; Dielectric properties; Thermal properties