

## DEVELOPMENT OF INSULATING MAGNETIC OIL FOR TRANSFORMERS

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The Centrais Elétricas do Norte do Brasil AS – Eletronorte, as well as other companies in the world energy sector, have problems of loss of the performance by excessive heat and even accidents with their transformers. The maintenance and accidents impact of energy supply, generating profit and more expensive insurance premiums. The transformers are essential devices in any matrix of generation, transmission and distribution of electric energy. Consequently, improving the efficiency of these devices should be considered in any program of aggregation of new technologies to the system of generation, transmission and distribution of electric energy. One of the most promising options in this direction is represented by the replacement of current mineral insulating oils for insulating magnetic developed from commercial insulating oils. The technological approach offered in this project is based on the dispersion of magnetic nanoparticles in insulating oils used today. Thus, instead of working with an insulating oil, work with a magnetic insulating oil, or a diluted magnetic fluid. The magnetic nanoparticles will cover molecular surface plays a dual role, first by preventing the aggregation of nanoparticles and, second, allowing its homogeneous dispersion in insulating oil. The introduction of magnetic nanoparticles in insulating oil is limited to a concentration (low volume fraction) does not change the technical characteristics of the oil within their specifications for operation on transformers. Moreover, the introduction of magnetic nanoparticles in insulating oil adds two properties essential to increase the efficiency of transformers. First, the process of heat exchange between the parties and the internal heat exchanger in the external parts of the device is not only the mechanism of Archimedes, but also by forced convection from the oil ironhidrodinamic magnetised. Second, the addition of magnetic nanoparticles to conventional insulating oil increases the dielectric strength of the resulting fluid, thereby enlarging the limit of operation of the device. Therefore, the combined effect of these two new features act to increase the efficiency of the transformer, with significant impact for the whole system of generation, transmission and distribution of electric energy. This project fits within it what may be called nanotechnology, since the gain in efficiency of the device is based on the behavior of magnetic nanoparticles dispersed in a way dispersant and under the action of gradients of magnetic field. Development of insulating magnetic oils is based on the production of a particular magnetic fluid (MF) sample, especially design for further dilution in a selected insulating oil. The as-produced MF sample can latter on be used for dispersion in the insulating oil in an appropriated nanoparticle volume fraction for maximization of the heat-transfer efficiency during the device operation. In this study we report on the successful preparation of special MF samples that can be dispersed in commercial insulating oils providing enough colloidal stability of the end product, namely the insulating magnetic oil, for testing the efficiency in heat-transfer in commercial transformers. Besides the characteristics of the special MF developed the approach for heat-transfer efficiency evaluation will be discussed as well.