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##### **Effect of spheroidization and normalization treatments on the electromagnetic behavior and microstructural transformations of ferritic-pearlitic steel wire for flexible marine pipelines**

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The tensile armor of flexible marine pipelines, responsible for the flow of oil and gas, is composed of the helical arrangement of steel wires, which are subjected to complex stress modes that can cause unpredictable failures. Electromagnetic non-destructive testing (NDT) techniques are suitable for monitoring morphological, microstructural and mechanical properties changes in deformed or heat-treated steels. Heat treatments play an essential role in improving material properties obtained from thermomechanical manufacturing processes. In this study, the microstructural transformations of a ferritic-pearlitic steel wire used in the manufacture of flexible pipelines were investigated, which was submitted to spheroidization and normalization heat treatments, with variation in time (30, 60 and 90 min) and temperature (600, 700 and 800 °C). With the aim of identifying a treatment that produces microstructure and mechanical properties more suitable for the application of the wires in question, and to investigate the capacity of electromagnetic methods to characterize and inspect tensile armor steels in areas of difficult access, analysis of Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD), Differential Scanning Calorimetry (DSC) and hardness tests were made, relating them to the electromagnetic behavior of Magnetic Barkhausen Noise (MBN), Magnetic Hysteresis and Electrical Resistivity signals. The results indicate that in spheroidization at 600 °C and 700 °C the recovery process occurs, facilitating the deformation of the material, but reducing its mechanical resistance. However, the behavior of the MBN envelope and the DSC curves suggest that both recovery and recrystallization processes occur only in the treatments at 700 °C and 800 °C, causing reduction in crystalline defects and increase in the grain boundary area. There is a reduction in coercivity and the area of the hysteresis curve with an increase in the degree of spheroidization, indicating greater ease in reaching magnetic saturation with the application of a smaller magnetic field. The MBN peak has a higher amplitude and lower energy to reach saturation due to the increased mobility of domain walls in spheroidized microstructure. In normalization, the MBN peak is smaller and the electrical resistivity is higher, as the pearlitic microstructure and the multiplication of grain boundaries in the recrystallization cause a more significant impediment to the movement of the domain walls and the flow of free electrons. The application of a deformation prior to heat treatment causes multiplication of dislocations that function as anchoring points for the magnetic domains, reducing the MBN.