1.1.24. RELATION OF THE MAGNETIC PROPERTIES OF CONTROL-ROLLED PIPE STEEL TO ITS STRUCTURAL ANISOTROPY, INTERNAL STRESSES AND DAMAGE

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Ferromagnetics magnetization (M) not only depends on the intensity of magnetization field (H), but also is the function of the whole number of such factors as temperature (T), variable magnetic field (σ), mechanical stress, time, chemical transformations. These factors act only when external constant magnetic field is available or ferromagnetic material is in the state of residual magnetization. Therefore, residual magnetization observed in constructions and used for evaluation of technical state can be the result of action of almost all above listed factors.

The main reason defining the resistance of magnetic states to the action of magnetic and electromagnetic fields, as well as elastic strains in steels is the delay of displacement of domain borders due to their interaction with magnetic imperfections of a material with defects of structure. Coercive force being structure sensitive magnetic characteristic reflects integral properties of ferromagnetic material and features its general resistance to external exposures. More detailed data on interaction of domain borders with defects of certain types can be obtained through examination of resistance of specific magnetic state (for example, residual magnetization) to exposures of magnetic and electromagnetic fields, elastic and plastic strains, and temperature.

In residual magnetization state, domain borders are fixed predominantly by magnetic imperfections of various types conditioned by non-uniform internal stresses, inclusions, sections with reduced efficient constant of magnetic anisotropy presented in ferromagnetics. Existence of defects within the steel structure with respective critical fields $H_к$ will define the degree of domain borders interaction with them and resistance of residual magnetization to exposure of constant and variable demagnetization fields or elastic strains. For example, exposure of ferromagnetic material being in the residual magnetization state by small-value constant demagnetization field $H^-_{p_1} >> H_{k_1}$ will result in displacement of domain borders and they will be fixed in a new position. When field value $H^-_{p_1}$ is reduced to zero, the regained state of residual inductionn $B^-_{d_1}$ will be less than Br by the value $B^-_{d_1}$. Value $B^-_{d_1}$ will feature the volume of ferromagnetic material ΔV_1, where residual induction has lost resistance under action of demagnetization field $H^-_{p_1}$. Further increasing of demagnetization field up to the value $H^-_{p_2}$ will result in new redistribution of domain borders in ferromagnetic material and residual indiction will decrease by the value $\Delta B^-_{d_2} = B^-_{d_1} - B^-_{d_2}$. Value $B^-_{d_1}$ will feature the volume of ferromagnetic material ΔV_2 with critical fields $H_{k_1} - H_{k_2}$ that has lost resistance of residual induction under action of field $H^-_{p_1} \le H_p \le H^-_{p_2}$. Sum value $\Delta B^-_{d_1}$ and $\Delta B^-_{d_2}$ makes it possible to evaluate over-magnetized volume with critical fields $0 - H_{k_2} \le H^-_{p_2}$.

Thus, changes in residual induction B_d depending on applied exposures will carry data on interaction of domain borders with structural defects of various types in metals; thus, finer tool for analysis of structural and stressed-strained state of articles and elements of steel structures is obtained.

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