Numerical Simulation in Alternating Current Field Measurement (ACFM) Inducer Design

Zhixiong Zhou, CNPC Drilling Research Institute, Block A34 CNPC Innovation Centre, W of Xishatun Bridge Shahe Town, Changping District, Beijing, 102206, China; Wenpei Zheng, China University of Petroleum-Beijing, 18 Fuxue Road, Changping, Beijing, 102249, China

Inducer design plays an important part in Alternating Current Field Measurement (ACFM). It involves influence analysis of some key parameters on the perturbation of the magnetic field above the crack. Experimental analysis methods are time-consuming, high cost and have experimental errors. Finite element method (FEM) can overcome these shortcomings, and is adopted in this paper to aid design of ACFM inducer. Two kinds of ACFM Inducer, twin coil and U-shaped inducer are proposed, and corresponding numerical simulation models are built. In the model for the U-shaped inducer, the inducer comprises a U-shaped core and a current-carrying coil. The specimen is modeled by a plate, and the surface breaking crack in the specimen is modeled by a semi-ellipse [1], as shown in Figure 1. The models are then verified by comparison with experimental data. After that, influence of various parameters, such as core material, core dimensions and inducer lift-off on the perturbed magnetic field above the crack is analyzed in the models and suggested parameters are given based on the influence analysis results. The numerical simulation results provide guidance to design of ACFM inducer.

Acknowledgement:

This work was supported by the National Natural Science Foundation of China (Grant No. 51404283), the PetroChina Innovation Foundation (Grant No. 2014D-5006-0602), and the Science Foundation of China University of Petroleum, Beijing (Grant No. 2462015YQ0403).

Figure 1. Numerical simulation model of the U-shaped inducer.

References: