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Mon-Mo-Po1.02-05 [17]: Stress Distribution of Magnetically Controlled Reactor Core in Gaps Area under Simulated Service Conditions

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In order to control and reduce the vibration of magnetically controlled reactors(MCRs) with gaps core structure, accurate stress computation should be carried out. Previously, researchers proposed a finite element model for reactors core stress calculation considering Maxwell stress theory and magnetostriction effect. Giant magnetostrictive materials are used to be filed into the gaps to reduce the electromagnetic force in iron cores between gaps. However, they did not compute MCRs core stress considering the hardness of the gap filler under service condition.
Under the MCRs service condition of AC and DC excitations, the main factors which have influence on stress distribution in gaps area include magnetostriction effect of silicon steel, electromagnetic force effect of iron cores between gaps and the hardness of the gap filler. The magnetostrictive stress and electromagnetic stress have been studied, but the influence of gaps filler hardness on the total vibration of MCRs has not been analyzed. This paper presents an electromagneto-mechanical coupled model for MCRs to analyze their stress distribution under service condition. Firstly, magnetostriction and magnetization properties for oriented electrical steel sheet along the rolling direction (RD) and the transverse direction (TD) under AC and DC excitations are tested. Then, based on the measured constitutive relations, an electromagneto-mechanical coupled model for MCRs considering electromagnetic force effect, magnetostriction effect and the hardness of inserted materials is presented and the stresses in different directions in gaps area are calculated. Finally, an MCR prototype is made and the core vibrations in gaps area under different AC and DC excitations are tested to prove the validity of the proposed model. From the calculated and experimental results, it can be seen that the vibration in the outer edge of cores is more serious than that in the center of cores.

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