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Tue-Af-Po2.24-05 [104]: Design and simulation of three-phase electromagnetic wiping device

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In order to solve the problem that the traditional gas wiping method cannot meet the needs of high-speed production, the oxidation and atomization of zinc liquid which not only wastes zinc, but also disperses zinc into the air to pollute environment, a three-phase electromagnetic wiping based on traveling wave magnetic field is proposed. By using a three-phase coil, a traveling wave magnetic field is generated which can induce electromagnetic force on the surface of the galvanized layer and wipe off excess zinc liquid. There is no direct contact between the device and the workpiece. The frequency and amplitude of the coil current are controlled to achieve the control of the thickness of the zinc layer. The zinc liquid on the workpiece is uniformly applied and the direction is clearly controllable, which does not cause sputtering of the zinc liquid.

Through the theoretical analysis, the electromagnetic and mechanical simulation models of the workpiece, zinc liquid, magnet and power source are established. The main parameters of the power supply and coil, the traveling wave magnetic field and the force of the zinc liquid are simulated. The simulation results show that under the action of the coil current of several tens of Hertz and several hundred amperes, the electromagnetic force generated by the device can achieve the wiping effect of the gas wiping on the zinc liquid. The three-phase electromagnetic wiping can generate greater axial stress, and the force is more uniform, and has a better wiping effect.

A three-phase electromagnetic wiping device prototype was developed. The coil adopts a circulating water cooling system to ensure that the coil can operate in a safe temperature range. The preliminary experimental results show that it can meet the requirements of high-speed hot dip galvanizing production and has broad application prospects.

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