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With the rapid development of electronic technology, investigation and application of devices with high performance of heat removal have become competitive issues recently. Different from traditional heat transfer strategy, many new promising ideas and technologies were introduced into thermal management, one of which is Oscillating Heat Pipe (OHP). In the current investigation, a theoretical analysis predicting the oscillating motion, heat transfer, and thin film evaporation occurring in the OHP is developed. The new model predicting the oscillating motion in an OHP can predict the effects of turn number and gravitational force in addition to the liquid charging ratio, operating temperature, working fluid, and heat input. Using the oscillating motion predicted with the new model developed, a heat transfer model predicting the temperature difference between the evaporator and condenser is developed. The thin film evaporation model includes the momentum effect on the thin film profile and evaporation. The model considers the effects of inertial force, disjoining pressure, surface tension, and curvature. The model can be numerically solved for the thin film profile, interfacial temperature, meniscus radius, heat flux distribution, velocity distribution, and mass flow rate in the evaporating thin film region. Furthermore, in the current investigation, a mathematical model predicting the minimum meniscus radius occurring in the sintered particles is developed. Moreover, a theoretical analysis predicting the charging process is conducted. The results provide a guideline for the charging process.