

Thesis topic: The Method of improving energy efficiency and performance of household appliances

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Keywords: energy efficiency, heat exchangers, energy recovery, household appliances, numerical modeling

Abstract

This doctoral thesis focuses on a crucial problem: how to make home appliances more energy-efficient. Despite technological advances, a significant amount of thermal energy is still wasted. It escapes with hot water, air, and is generated by operating parts. This energy loss not only means higher bills but also a greater environmental impact, which violates new, increasingly stringent environmental standards. The aim of this research was to find new ways to recover this wasted energy.

The main task was to design, test, and refine heat exchangers that could be integrated into household appliances. The goal was to improve their efficiency and reduce water consumption. To achieve this, the author used both advanced computer simulations and practical tests. The thesis describes the latest technologies in heat recovery and selects the best materials—those that conduct heat well and do not corrode, which is crucial for durability.

Three ingenious solutions were presented that, working together, are designed to maximize energy recovery:

1. Counterflow heat exchanger: designed for installation on the side of the dishwasher, it recovers heat from the water that is already draining to heat the cold water that is yet to be used.
2. Heat exchanger integrated with the BLDC motor: this solution cools the motor, ensuring better and longer performance.
3. Modular heat exchanger: a flexible design, it can be easily adapted to fit inside various household appliances, even those with limited space.

The study examined whether using these three solutions together would reduce energy consumption by more than 15%. To confirm this, computer simulations (CFD) were used to accurately model heat flows. The simulation results were then confirmed in prototype tests.

Both simulations and field tests demonstrated that the hypothesis was correct. The proposed solutions, when used together, truly have the potential to significantly reduce energy consumption in dishwashers. This work not only provides a theoretical basis for creating more efficient heat exchangers, but also proposes ready-to-implement ideas that can contribute to further improving energy efficiency in home appliances.