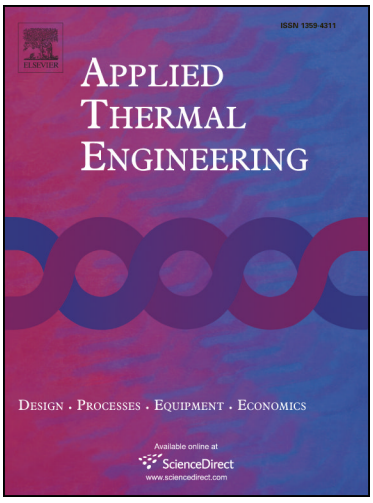

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Domestic Thermoelectric Cogeneration System: Optimization Analysis, Energy Consumption and CO_2 Emissions Reduction

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Abstract

In this paper, a domestic thermoelectric cogeneration system (DCS) is suggested. This system permits to use the lost heat of exhaust gases to simultaneously heat water and produce electricity via thermoelectric generators (TEG). To proceed, the concept of the system is drawn and the corresponding thermal modeling is developed. An optimization analysis, based on the position of the thermoelectric generators within the system, is carried out using the thermal modeling. The TEGs are places on the inner or outer walls of the tank or the pipe (cases 2-5), or on all of them (case 6). Results show that water can be heated to up to 97°C, when TEGs are located on the inner wall of the tank. More the TEGs are nearer to the exhaust gases, higher is the total power produced by the TEGs and lower is the water temperature. The power produced by one TEG in direct contact with the exhaust gases is 0.35 W and the water temperature is 76°C. Also, a DCS with TEG located at all layers can generate up to 52 W and 81 °C hot water, however this configuration has high initial cost. An economic and environmental concerns are considered. Results show that DCS with TEGs located on the inner wall of the pipe has a payback period of 1 year and 8 months when water is heated 60 times per month. In addition to that, it was shown that the location of TEGs do not affect the amount of CO_2 gas reduced which is about 6 tons yearly. Finally, this study shows that the configuration where TEGs are placed at the inner wall of the pipe is the most cost-effective energy recovery configuration.