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Technical feasibility of operating Organic Rankine Cycle with waste heat

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Sri Lanka has to rely on thermal power generation for reliability of the national electricity grid, especially during droughts or dry seasons, due to frequently changing climatic patterns. For thermal power generation, the country is entirely dependent on imported fuels and therefore, it is vital that the thermal power plants of Sri Lanka should be operated in a cost effective manner. The exhaust gas temperatures of thermal power plants are usually in the range of 290 °C – 320 °C which indicates that a considerable amount of thermal energy is wasted without being used. This study was undertaken at a power station where a part of this energy is recovered and used to produce saturated steam using waste heat boilers, which are used for heating heavy fuel oil used for gas turbines in order to increase the efficiency. The practical limitation of recoverable heat from exhaust gasses can be determined by the sulfur dew point of the fuel which is usually 135 ^{o}C.The study was conducted with the objective of recovering the maximum possible heat from the exhaust of a diesel engine and utilizing the recovered heat to operate a power plant based on the Organic Rankine Cycle, with the working fluid being toluene, which is best suited for low temperature heat sources. The Organic Rankine Cycle was optimized using Engineering Equation Solve Software based on the constraints imposed by the sulfur dew point of the fuel and the pinch point temperature difference. The study established the parameters of the Organic Rankine Cycle as: pinch point temperature difference - 2.011 ^{o}C, turbine power - 570.6 kW, condenser pressure -0.07 bar, mass flow rate of toluene - 3.298 kg/s and thermal efficiency - 20.95% for optimum conditions.

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