



TEAM 32

Waste Heat Recovery Using Thermoelectric Generator(TEG)

KFUPM Design Expo

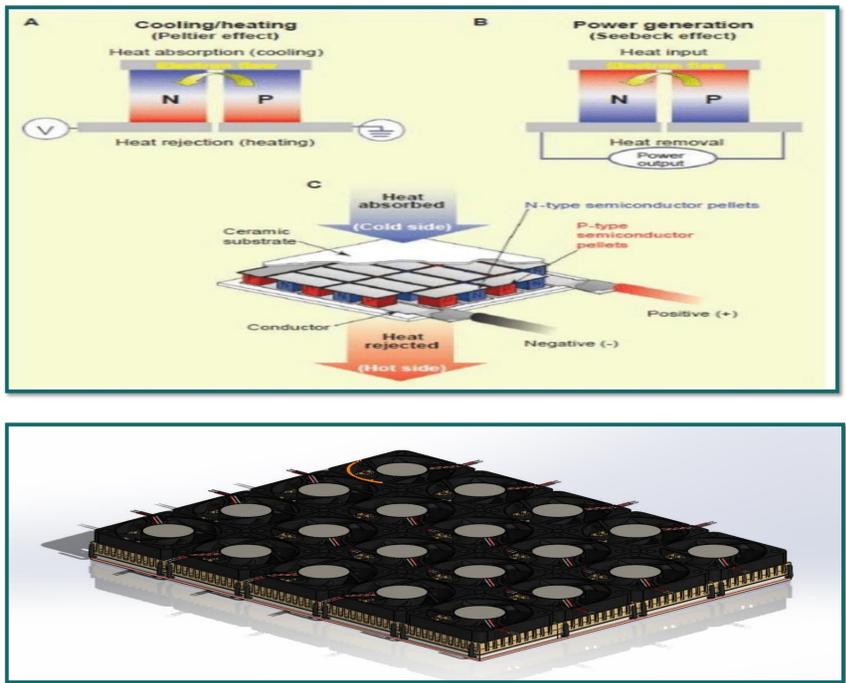
Introduction

Steel production companies face high energy costs and environmental impacts due to wasted heat during manufacturing. Our Flexible Thermal Fabric with Thermoelectric Generators (TEGs) offers a compact, flexible, and scalable solution to recover and convert waste heat into electricity directly at the source. Unlike traditional systems like steam turbines, it efficiently captures heat from irregular industrial surfaces, improving energy efficiency while reducing maintenance needs and costs.

Specifications

- Thermal Cycling Resistance: Endure up to 1000 thermal cycles without degradation
- Energy Output: Produce at least 500 W/h.
- Maintenance: Every 2 months.
- Thermal Conductivity: Be in the range 100-500 W/m.K for efficient heat transfer
- Heat Transfer: Transfer 80% of heat through the sheet
- Life Span: 20 years

Prototype



Constraints

- Heat source produce a temperature of 100°C to 300°C
- Maintenance Cost not exceeding 5% to 10% per year of the initial cost.
- Design suitable for the existing factory infrastructure.
- TEG Conversion 5% to 10%.
- Material resistance up to 300°C for prototype

Testing

Energy Output	$2.25 * 0.36 * 1000 = 810 \text{ W/h}$
Lifespan	200000 Hours = 22 years
Thermal Conductivity	Copper = 400 W/m.K
Maintenance:	Solid-state devices with no moving parts
Thermal Cycling Resistance	High-quality bismuth telluride modules can withstand 500 1500 thermal cycles

Conclusion

The project converts waste heat into electricity using thermoelectric generators, offering an efficient, adaptable, and cost-effective solution. It enhances energy efficiency, reduces costs, and promotes sustainability, providing a practical alternative to traditional systems.