WASTE HEAT RECOVERY FROM INDUSTRY

ANKIT DHITAL

ME-113 Thermodynamics

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ABSTRACTS

Focus: Industrial waste heat recovery (WHR) to improve energy efficiency

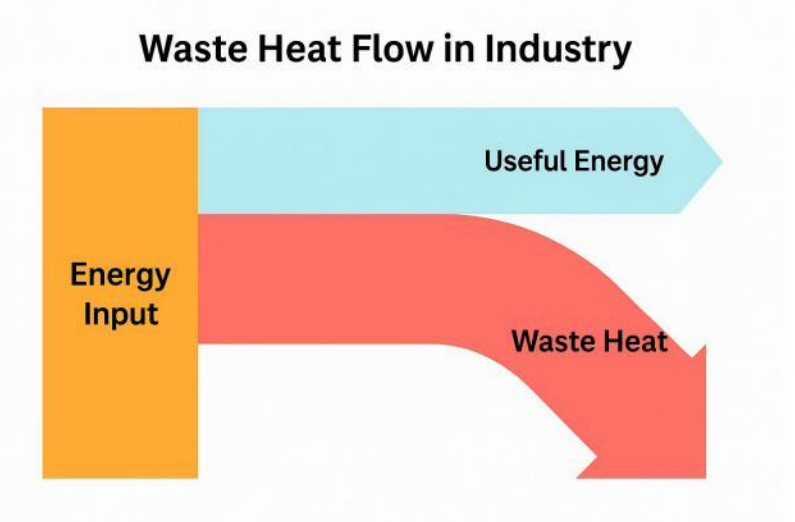
Waste heat: Lost of thermal energy from exhaust gases, hot surface, etc.

Common technologies: Heat exchangers, Organic Rankine Cycle, regenerators

Benefits: Lower fuel consumption, reduced emissions and cost saving

INTRODUCTION

- What is a Waste Heat?
- Up to 50% of industrial energy is lost as waste heat
- Reclaiming it improves thermal efficiency and reduce fuel usage.
- Direct application of Second Law
- Harnessing energy before it becomes unavailable

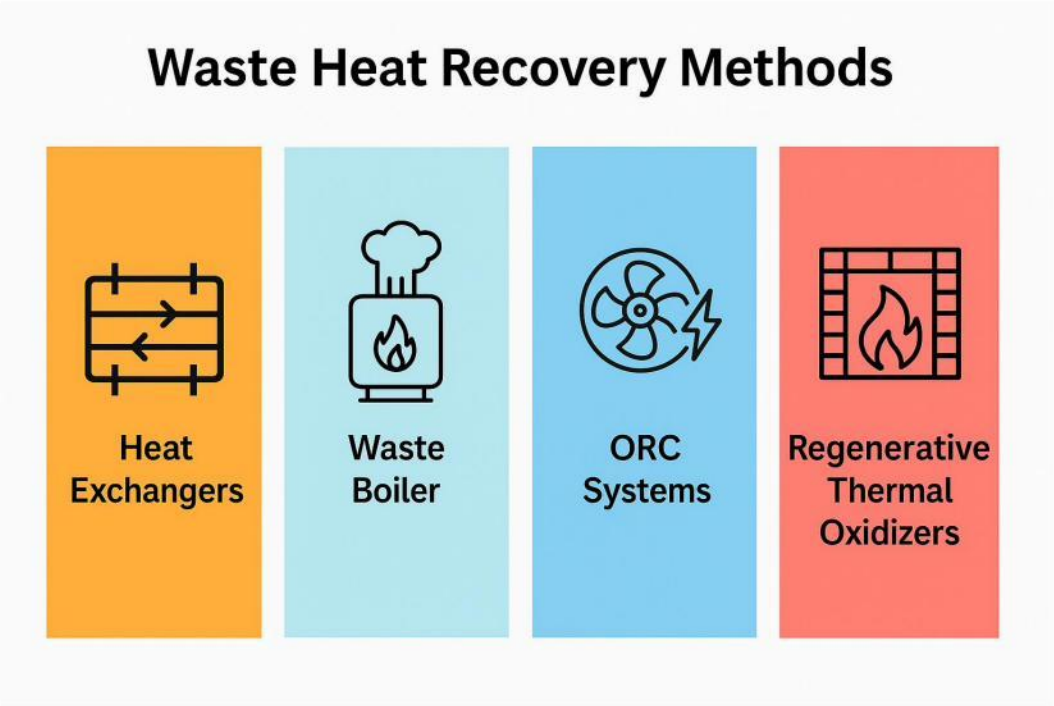


INDUSTRY ADOPTION

- Cement: WHR used to generate 5-9MW of electricity per plant.
- Steel: Trials in capturing Electric Arc Furnace (EAF) exhaust heat.
- Food: Modern adoption using heat exchanger from oven, boilers.

TECHNOLOGIES IN USE

- Heat Exchangers: Most widely used (economical, recuperators)
- ORC System: Suitable for medium-tempr (150-230°C) waste heat
- Regenerators: Uses in high temperature cyclic operations



RESEARCH TREND

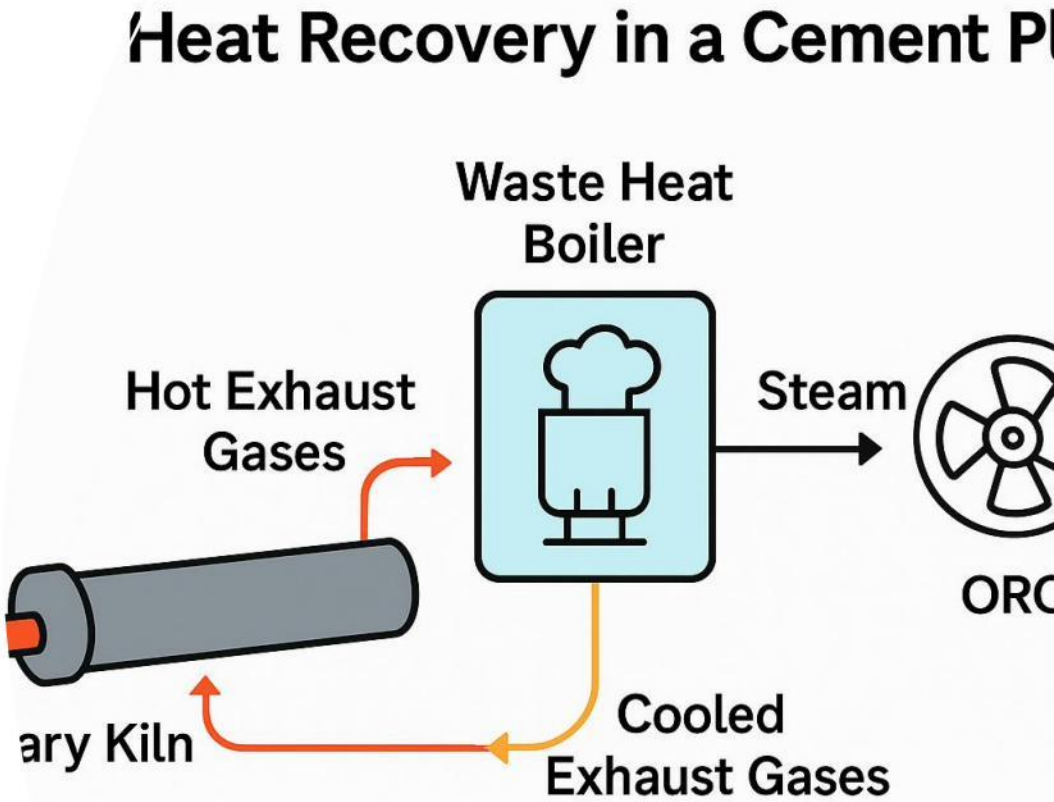
Focus on:

- Low grade heat recovery
- Advanced fluids for ORC
- Thermoelectric materials

Emphasis on energy audits and integration with renewables

CEMENT INDUSTRY

- Kiln exhaust and clinker cooler provides major WHR potential
- WHR system can meet 30% of internal electricity needs.



STEEL INDUSTRY

- Challenges: Intermittent heat from batch processes.
- Example: ORI Martin (Italy) uses EAF exhaust to generate 2.2 MW of power

FOOD INDUSTRY

HEAT EXCHANGER USED TO PREHEAT WATER AND AIR

ABSORPTION CHILLERS DRIVEN BY WASTE REDUCES ELECTRICITY USE

COMPARATIVE SUMMARY

INDUSRTY	WASTE HEAT SOURCE	COMMON WHR METHOD	BENIFITS
CEMENT	KILN EXHAUST	ORC, BOILERS	POWER SAVINGS, EMMISSION CUT
STEEL	FURNACE OFF-GAS	HEAT EXCHANGER, ORC	DUAL USE: HEAT+POWER
FOOD	OVENS, COOLING WATER	HEAT EXCHANGER, CHILLERS	HOT WATER, REFRIGERATION

WHY MOVE FORWARD

Economical: Reduces energy cost and payback within 3-5 years

Environmental: Major emission reductions, supports net-zero goals.

Thermodynamic Justification: Prevents further energy degardation

NEXT STEPS

1

Conduct site-specific energy audits

2

Prioritize retrofits in high waste sectors (cement, steel)

3

Encourage policy incentives for industries adopting WHR

SUMMARY

Waste heat recovery is practical and thermodynamically sound

Proven tech exists (heat exchanger, ORC)

Wider adoption depends on addressing challenges

WHR aligns with sustainable development and thermodynamics principles

REFRENCES

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- Case studies: ORI Martin Steelworks (Italy); Cement WHR in India and Turkey (various industry reports).
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