ECN

Energy research Centre of the Netherlands

Waste Heat Technology

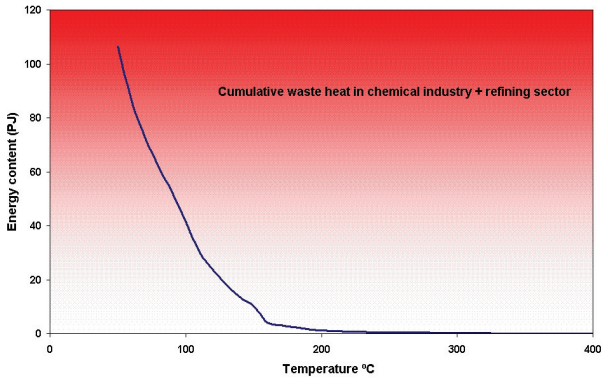
Background

The Energy Research Centre of the Netherlands ECN at Petten is an independent market-oriented organisation for research, development, consultancy and knowledge transfer in energy-related fields. ECN develops sustainable technologies and is engaged in work on solar, wind and biomass energy, fossil fuels, energy efficiency and policy studies.

More than 80% of the total energy use in the Dutch industry involves the need for heat, either in fired furnaces or in the form of steam at different pressure levels. Most of this heat is eventually released to the ambient atmosphere through cooling water, cooling towers, flue gasses, and other heat losses. We call this heat loss 'Industrial waste heat'. Large energy savings are possible, if this waste heat could be reused.

Industrial waste heat

A detailed study of the magnitude of the waste heat within the Dutch chemical and refining industry revealed the picture below. Yearly, more than 100 PJ of heat above 50°C from sources larger than 0.5 MW is actively cooled from process streams to the ambient atmosphere within these industrial sectors.



Cumulative waste heat identified within the chemical and refining sectors

The total industrial waste heat in the Netherlands is estimated at more than 250 PJ per year if in addition flue-gas losses and waste heat in other industrial sectors are taken into account.

Solutions

Heat integration forms the first solution to prevent waste heat. This has already been applied to a great extent in the Dutch industry (pinch technology). The problem with the remaining waste heat, beside the fact that there are many single sources, is that:

- The temperature level of the waste heat is too low to be reused again at the same site.
- The waste heat is released at a different time when heat is needed.
- The location where heat is needed is too far away from the source of waste heat.

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The research group ‘Waste Heat Technology’ develops cost-effective technological solutions for upgrading or storing waste heat. Waste heat can be upgraded to process heat or cold by applying innovative heat-pump concepts, which can provide high-temperature lifts in a wide temperature range. Waste heat can be economically stored by applying heat-storage concepts that are compact and have low thermal losses.

Technologies

ECN is working on two innovative heat pump concepts that are in principle able to upgrade waste heat with the required efficiency in the required temperature range. These heat pumps are based on either the thermochemical principle or the thermoacoustic principle.

A thermochemical heat pump uses reversible absorption and desorption reactions of a vapour (water, alcohol, ammonia, hydrogen) with a solid (salt, ceramic, metal). Based on this principle a large variety of applications (heat and cold production) can be developed, driven by waste heat.

Test installation of a thermochemical heat pump

A thermoacoustic heat pump is based on the physical phenomenon that a sound wave is able to create a temperature difference in interaction with a porous medium. This enables the development of a heat pump or cooler driven by waste heat or high-temperature sources.

Test installation of a thermoacoustic heat pump

Work on heat storage is focused on high-temperature (>100°C) storage with Phase Change Materials (PCM) or chemical sorption reactions.

Test installation for testing phase change materials

Clients, partners and sponsors stem from the major process industries, small and medium enterprises, the European Union, national and local governments, universities and research institutes.

Interested in an energetic and challenging technology venture with us: Call ECN!

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