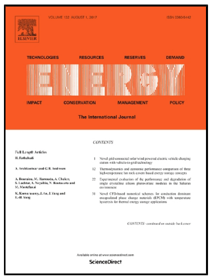
Accepted Manuscript



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PII: S0360-5442(17)31124-6

DOI: 10.1016/j.energy.2017.06.126

Reference: EGY 11134

To appear in: *Energy*

Received Date: 17 October 2016

Revised Date: 29 May 2017

Accepted Date: 20 June 2017

Please cite this article as: T. Duh Čož, A. Kitanovski, A. Poredoš, Exergoeconomic optimization of a district cooling network, *Energy* (2017), doi: 10.1016/j.energy.2017.06.126

Exergoeconomic optimization of a district cooling network

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Abstract

A district cooling system (DCS) is superior to conventional air conditioning as it helps to reduce energy consumption and protect the environment by reducing carbon dioxide emissions. The main disadvantages of a DCS are the high initial investment costs and the long payback period. The distribution network (DN) represents a large share of initial investment costs; therefore, it has a great impact on the decision to construct a DCS. In order to ensure the competitiveness of DCS, the DN has to be optimized. In this paper the exergoeconomic concept is applied to evaluate a DN in a DCS. The objective function in the analysis is defined as the exergy based cost of the final product-cold. The exergy-based cost of cold depends on the total annual cost of a DN, the input exergy to the DN, the exergy losses and the exergy destruction. The aim of this study is to find the exergetic optimal pipe diameter and the insulation thickness, as well as the exergoeconomic optimal pipe diameter and the insulation thickness. The analysis was made for different cooling capacities and for two types of pipes: pre-insulated steel pipes, where the insulation material is polyurethane, and polyethylene pipes, without any insulation.

Keywords: Exergoeconomic Analysis, District Cooling Network, Optimal Diameter, Exergo-Economic Optimal Insulation Thickness

Nomenclature

c	Specific costs (€/kWh)	*DCS*	District cooling system
c_p	Specific heat capacity ($\mathrm{J/(kg \cdot K)}$)	*DN*	District network
C	Internal pipe circumference (m)	*el*	Electric
$\dot{C}$	Cost rate associated with an exergy stream (€/s)	*Ex*	Exergy
d	Internal diameter (m)	*F*	Fuel
e	Specific exergy (J/kg)	*g*	Heat gains
E	Exergy (J, kWh)	*i*	Internal
$\dot{E}$	Exergy rate (W)	*in*	Inlet
f	Darcy's friction factor (/)	*L*	Losses
h	Specific enthalpy (J/kg)	m	Motor
L	Length (m)	OM	Operating and maintenance
$\dot{m}$	Mass flow rate (kg/s)	*out*	Outlet
P	Power (W)	*P*	Product