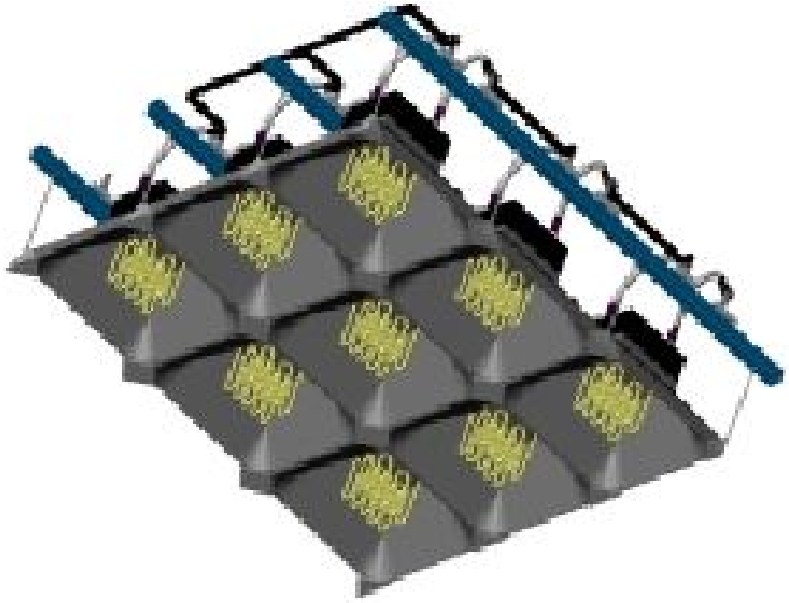
KANTHAL MÄLARDALEN UNIVERSITY

Optimization of Kanthal Superthal High Power Reflectors



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Abstract

Kanthal AB, the market's foremost supplier of heating solutions to industry, often creates optimum solutions for each customer. One of their solutions is the High Power Reflector, which consists of a vacuum formed ceramic fibre 'hood' with an integrated Kanthal Super ceramic heating element. The performed project is to optimize heat performance of the High Power Reflector with respect to output power and temperature distribution. The task was solved using heat transfer simulations in with reflector different models. The simulation in COMSOL software environment in two-dimensional was performed to find the best reflector shape. Authors have simulated five different types of proposed reflectors. The temperature distributions were simulated as well as temperature profile and curve in 20 cm on the top of element until 50 cm have obtained, in this way with respect to higher out power and uniform temperature distribution, was found the optimized model of reflector and hood for using in power heating system. For verification used the three-dimensional simulation. It is shown that the difference is less than of 3%. Results have a satisfied fit with furnace average temperature. In this research Kanthal AB handbook has been our reference for comparison. In future work to verify the simulations, tests can be performed at Kanthal's facilities.

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1 Background

Kanthal AB is the markets foremost supplier of heating solutions to industry. Based on long experience and extensive research and development Kanthal has a unique capacity to create optimum heating solutions for each customer's requirement.
One of Kanthal's many heating solutions is called Superthal, which consist of vacuum formed ceramic fiber shapes with an integrated Kanthal Super ceramic ($MoSi_2$) heating element. The Kanthal Super ceramic heating elements are provided in different qualities, and can be operated at element temperatures up to 1900°C.
The Superthal High Power Reflector is a compact fiber insulated modular heater with so-called 'cubic' Kanthal Super elements, see Fig. 1. It is designed for a power of up to 110kW/m^2 at 1650°C.
Multiple units can easily be joint together in different configurations e.g. in rows or squares. The Superthal High Power Reflectors are used wherever a concentrated high power at temperatures of up to 1650°C is needed, for instance in single billet heating, aluminum melting furnaces or ladle heaters.

Fig. 1 A Kanthal Superthal High Power Reflector [1].

According to Kanthal AB policy, to find the complete report contact with the following contact persons, please.

www.kanthal.com

Supervising and organization

This project has been supervised by Mälardalen University, IST department, Professor Jafar Mahmoudi, Ph.D, and so Dr. Örjan Danielsson from Kanthal AB; Ph.D. student Kourosh Mousavi Takami has performed this task.

Biography

Kourosh Mousavi Takami was born in Sari, Mazandaran,Iran . He received the B.S.c. degree in electric power engineering from the Iran University of Science and Technology (IUST) Tehran, Iran, Oct1995 and the M.Sc. degree in electric power engineering from the Engineering Faculty of Mazandaran University, Iran in 2002. Currently, he is PhD student at Mälardalen University in Sweden since 2005. He has so over ten years experience in power system design and installations.
His research interests include Optimization and simulation of heat generation and transfer in the core and winding of power transformers; diagnostic testing and condition monitoring of power equipments, and application of fuzzy and Ants algorithm to condition monitoring of power equipments.
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Örjan Danielsson was born in Falun, Sweden, He recieved his M.Sc. degree in Electrical Engineering and Applied Physics at Linköping University in 1998, and his PhD degree in Materials Science at Linköping University in 2002. He has over ten years of experience of modelling and simulations of thermodynamics, heat transfer, electromagnetics, fluid flow and chemical reactions, both at universities and in industry. At his present position as Senior Simulation Specialist at Kanthal AB, Hallstahammar, Sweden, he is focusing on thermal engineering for industrial heating systems, processes and applications.
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Jafar Mahmoudi was born in Tehran, Iran. He received the B.Sc., M.Sc. Degree in Sharif University and PhD degrees from KTH University, Stockholm, Sweden. Currently, he is a Professor with the Department of Public Technology Engineering in MdH University, Västerås, and Sweden.
His major research focus is development of new technology and methods for industrial energy optimization with special focus on heat and mass transfer. He has years of theoretical & experimental- experience on this. He also has a broad technical background encompassing thermodynamic, numerical methods and modelling (CFD computation) as well as materials science. This in combination with his industrial experience has served as a solid basis to build upon in expanding his research activities and focusing on relevant and current industrial issues.
Over the last 10 years his focus has been on the practical and industrial application of the above mentioned methods, an effort conducted in a large number of industrial projects. In this, his teaching experience has proved invaluable.
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References

[1] KANTHAL SUPER Electric Heating Element Handbook, ISBN 91 86720 08-2, 1999, Hallstahammar, Sweden.