Ain Shams University
Faculty of Engineering
Mechanical Power Department

Effect of Impinging Rotating Jets on Horizontal Cylinder Cooling

A thesis submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCINCE
In
MECHANICAL ENGINEERING

By

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B.Sc. Mechanical Engineering

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STATEMENT

This thesis is submitted in the partial fulfillment of master degree in Mechanical Power Engineering, Ain-Shams University.

The author carried out the work included in this thesis, and no part of this thesis has been submitted for a degree or qualification at any other university or institution.

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Abstract

Experimental investigations have been conducted on the effect of quenching of hot horizontal stainless-steel cylinder by sub-cooled liquid water jets.

Many studies dealt with fixed circular jets, and few investigated the usage of rotating jets. Investigating quenching phenomena has important impact on some industries such as steel hardening.

The cooling rates have been studied for changing different parameters, such as cylinder initial temperature (250,350 and 450°C), coolant temperature (degrees of sub-cooling between 20°C and 60°C), number of jets (No. of jets 1, 2 and 3 jets) and jets rotation speed (N_j = 0, 20, 40 and 60 rpm).The coolant was impinged from jet/jets with diameter D_j= 4 mm to the center of the cylinder. The jets were 5 cm above the cylinder in the vertical direction.

These parameters will be discussed to achieve the optimum cooling rates and homogenous temperature distributions all over the cylinder surface, which enhances the cooling process and the heat treatment as a consequence.

The study deduce that the cooling effect of the triple jets appears at angles 90° to 180° and shows that it achieves better cooling at near surface impinging points than double or single jet impinging.

Using jet rotation speed N_j= 20 rpm, the surface temperature decreases faster than static or any jet rotation at angles 150-180°.

Also using rotating triple jet achieves more homogenous distribution of temperature than using fixed jets.

Key Words: Impinging Rotating Jets, cylinder quenching, boiling heat transfer.

SUMMARY

Experimental work has been done to study the effect of jet impinging rotating jets on horizontal cylinder cooling made from stainless steel by using circular jets.

Changing parameters such as the initial temperature, rotation speed and number of jets have been done to investigate its effects.

The study consists of five chapters as follow:

Chapter one: consists of introduction and a brief definition of quenching and quenching history and then take up some of quenching techniques and applications, finally discuss the challenges of quenching process and the outline of this dissertation.

Chapter two: includes a literature review of some of the previous researches which is interrelated with the subject of this study with brief summary for each of them. Then, the purposes of this study is discussed.

Chapter three: consists of the explanation of the experimental step up and procedure used in this study, the operation, and the investigated parameters.

Chapter four: deals with the results of the tests, analysis of these results, and the phenomena and criteria determined from them.

Chapter five: represents the conclusions from this study. and the future recommended for further investigations.

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