



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 SCIENCE  
In  
MECHANICAL ENGINEERING

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## STATEMENT

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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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## Research Data

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## Abstract

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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.

# TABLE OF CONTENT

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**Acknowledgement**

**Abstract**

**Table of contents**

**List of Figures**

**List of Tables**

**Nomenclature**

<b>Chapter 1: Introduction.....</b>	<b>1</b>
<b>1.1. GENERAL.....</b>	<b>1</b>
<b>1.2. Definition of quenching.....</b>	<b>1</b>
<b>1.3. History of quenching.....</b>	<b>1</b>
<b>1.4. Quenching techniques.....</b>	<b>1</b>
<b>1.5. Application of Quenching.....</b>	<b>2</b>
<b>1.5.1. Manufacturing industry.....</b>	<b>3</b>
<b>1.5.2. Cooling of gas turbines.....</b>	<b>3</b>
<b>1.5.3. Cooling of nuclear reactors.....</b>	<b>3</b>
<b>1.6. Jet impingement quenching.....</b>	<b>3</b>
<b>1.7. Regions of the cooling curves.....</b>	<b>4</b>
<b>1.8. Challenges of quenching process.....</b>	<b>5</b>
<b>1.9. Outline of This Dissertation.....</b>	<b>5</b>
<b>Chapter 2: Literature Review</b>	
<b>2.1. General.....</b>	<b>6</b>
<b>2.2. Literature on jet impinging on a cylinder specimen.....</b>	<b>6</b>
<b>2.2.1. Jet impinging on a fixed cylinder specimen.....</b>	<b>6</b>
<b>2.2.2. Jet impinging on a rotating cylinder specimen.....</b>	<b>10</b>
<b>2.2.3. Jet impinging on a flat plate specimen.....</b>	<b>12</b>
<b>2.3. Concluding remarks.....</b>	<b>13</b>



2.4. Objectives of the present study.....	13
Chapter 3: Experimental work.....	14
3.1. Introduction.....	14
3.2. Test rig.....	14
3.3. Specimen.....	16
3.4. Specimen heater.....	17
3.5. Thermocouples.....	18
3.6. Electric motor.....	18
3.7. Data acquisition unit.....	18
3.8. Water flow meter.....	18
3.9. Uncertainty of measurements.....	19
3.10. Investigated parameters.....	19
3.11. Experiments procedures.....	19
3.11.1. Changing the initial temperature of the specimen ( $T_{\text{initial}}$ ).....	20
3.11.2. Changing the coolant temperature ( $\Delta T_{\text{sub}}$ ).....	20
3.11.3. Changing Jet Rotation speed ( $N_j$ ).....	20
3.11.4. Changing number of jets (No. of jets).....	20
Chapter 4: Results and Discussion.....	21
4.1. Introduction.....	21
4.2. Experimental Results.....	21
4.2.1. Effect of Specimen Initial Temperature ( $T_{\text{initial}}$ ).....	21
4.2.2. Effect of increasing no. of jets (single/double/triple) jets.....	25
4.2.3. Effect of water sub-cooling ( $\Delta T_{\text{sub}}$ ).....	33
4.2.4 Effect of jet rotation speed $N_j$ .....	37
4.2.4.1 Effect of jet rotation speed on cooling curves.....	37
4.2.4.1.1 Using single jet.....	37
4.2.4.1.2 Using double jet.....	45
4.2.4.1.3 Using triple jets.....	48

4.2.4.2	Effect of jet rotation speed on homogeneity of specimen.....	51
4.2.4.2.1	Effect of jet rotation speed on homogeneity when acting with single jet impinging.....	51
4.2.4.2.2	Effect of jet rotation speed on homogeneity when acting with double jet impinging.....	58
4.2.4.2.3	Effect of jet rotation speed on homogeneity when acting with triple jet impinging.....	63
4.2.5	Effect of No. of jets on homogeneity.....	68
4.2.5.1	Comparison between single, double and triple water jets (fixed jets).....	68
4.2.5.2	Comparison between single, double and triple water jets (rotating jets).....	71
Chapter 5: Conclusions and Future Directions.....		74
5.1.	Introduction.....	74
5.2.	Summary of previous effects .....	74
5.2.1	Effect of Specimen Initial Temperature ( $T_{\text{initial}}$ ).....	74
5.2.2	Effect of increasing no. of jets (single/double/triple) jets.....	74
5.2.3	Effect of water sub-cooling ( $\Delta T_{\text{sub}}$ ).....	74
5.2.4	Effect of jet rotation speed on cooling curves.....	75
5.2.5	Effect of jet rotation speed on homogeneity of specimen.....	75
5.3.	General conclusions.....	75
5.4	Direction for Future Work.....	76
References.....		77

# List of Figures

---

<b>Fig.1.1: spray impingement.....</b>	<b>2</b>
<b>Fig.1.2: application of quenching in industry.....</b>	<b>3</b>
<b>Fig.1.3:jet impingement quenching zones, Mozumder.....</b>	<b>4</b>
<b>Fig.1.4:Typical experimental quenching curve.....</b>	<b>4</b>
<b>Fig.2.1: Change in radial heat flux of a carbon steel specimen.....</b>	<b>7</b>
<b>Fig.2.2: The principle of flexible sample quenching by gas jets.....</b>	<b>7</b>
<b>Fig. 2.3: The positions <math>r_q</math> , <math>r_s</math> and <math>r_w</math> at specific time (<math>t = 2.7</math> sec) on the flow boiling aspect and the values of <math>q_w</math>, <math>T_w</math>, <math>h</math> and <math>h_s</math> for each position...8</b>	
<b>Fig. 2.4: Hydrodynamic phenomena on the surface together with the cooling curve and surface heat flux at <math>t = 4.8</math> sec.....</b>	<b>9</b>
<b>Fig.2.5: Comparison between single and triple jet, experimental and numerical.....</b>	<b>10</b>
<b>Fig. 2.6: Influence of the wall speed at the centerline of the jet, <math>u_j = 1.06</math> m/s; <math>\Delta T_{sub} = 18</math> K.....</b>	<b>11</b>
<b>Fig.2.7: Comparison of cooling curves for three different velocities (<math>N = 0, 30</math> and <math>60</math> rpm).....</b>	<b>12</b>
<b>Fig. 3.1: Layout of Experimental test rig.....</b>	<b>16</b>
<b>Fig 3.2: Experimental test rig.....</b>	<b>16</b>
<b>Fig 3.3 schematic diagram of the working area.....</b>	<b>17</b>
<b>Fig 3.4 Test specimen.....</b>	<b>18</b>
<b>Fig. 4.1, Effect of <math>T_{initial}</math>, using fixed jet comparison between, <math>T_{initial} = 450, 350</math>, and <math>250</math> °C, <math>\Delta T_{sub} = 20</math> °C, <math>V_{jet} = 2.5</math> m/s, No.of jets = 1.</b>	

	a) Outer TC, $\Theta=0^\circ$ . b) Outer TC, $\Theta=90^\circ$ . c) Outer TC, $\Theta=180^\circ$ .....	24
<b>Fig. 4.2,</b>	<b>Effect of <math>T_{\text{initial}}</math>, using fixed jet comparison between <math>T_{\text{initial}} = 450</math>, 350, and 250 <math>^\circ\text{C}</math>, <math>\Delta T_{\text{sub}} = 20</math> <math>^\circ\text{C}</math>, <math>V_{\text{jet}} = 2.5</math> m/s, No. of jets = 1. a) Inner TC, <math>\Theta=0^\circ</math>. b) Inner TC, <math>\Theta=90^\circ</math>. c) Inner TC, <math>\Theta=180^\circ</math>..</b>	<b>25</b>
<b>Fig. 4.3,</b>	<b>Effect of <math>T_{\text{initial}}</math>, using fixed jets comparison between <math>T_{\text{initial}} = 450</math>, 350, and 250 <math>^\circ\text{C}</math>, <math>\Delta T_{\text{sub}} = 20</math> <math>^\circ\text{C}</math>, <math>V_{\text{jet}} = 2.5</math> m/s, No. of jets = 3. a) Inner TC, <math>\Theta=0^\circ</math>. b) Inner TC, <math>\Theta=90^\circ</math>. c) Inner TC, <math>\Theta=180^\circ</math>..</b>	<b>26</b>
<b>Fig. 4.4,</b>	<b>Effect of number of jets, comparison between No. of jets = 1, 2 and 3. <math>T_{\text{initial}} = 450</math> <math>^\circ\text{C}</math>, <math>\Delta T_{\text{sub}} = 20</math> <math>^\circ\text{C}</math>, <math>V_{\text{jet}} = 2.5</math> m/s, a) Outer TC, <math>\Theta=0^\circ</math>. b) Outer TC, <math>\Theta=90^\circ</math>. c) Outer TC, <math>\Theta=180^\circ</math>.....</b>	<b>28</b>
<b>Fig. 4.5,</b>	<b>Effect of number of jets, comparison between No. of jets = 1, 2 and 3. <math>T_{\text{initial}} = 450</math> <math>^\circ\text{C}</math>, <math>\Delta T_{\text{sub}} = 20</math> <math>^\circ\text{C}</math>, <math>V_{\text{jet}} = 2.5</math> m/s, a) Outer TC, <math>\Theta=0^\circ</math>. b) Outer TC, <math>\Theta=90^\circ</math>. c) Outer TC, <math>\Theta=180^\circ</math>.....</b>	<b>29</b>
<b>Fig. 4.6,</b>	<b>Effect of number of jets, comparison between No. of jets = 1, 2 and 3. <math>T_{\text{initial}} = 450</math> <math>^\circ\text{C}</math>, <math>\Delta T_{\text{sub}} = 40</math> <math>^\circ\text{C}</math>, <math>V_{\text{jet}} = 2.5</math> m/s, a) Outer TC, <math>\Theta=0^\circ</math>. b) Inner TC, <math>\Theta=0^\circ</math>.....</b>	<b>30</b>
<b>Fig. 4.7,</b>	<b>Effect of number of jets, comparison between No. of jets = 1, 2 and 3. <math>T_{\text{initial}} = 450^\circ\text{C}</math>, <math>\Delta T_{\text{sub}} = 40^\circ\text{C}</math>, <math>V_{\text{jet}} = 2.5</math> m/s, a) Outer TC, <math>\Theta=90^\circ</math>. b) Inner TC, <math>\Theta=90^\circ</math>.....</b>	<b>31</b>
<b>Fig. 4.8,</b>	<b>Effect of number of jets, comparison between No. of jets = 1, 2 and 3. <math>T_{\text{initial}} = 450</math> <math>^\circ\text{C}</math>, <math>\Delta T_{\text{sub}} = 40</math> <math>^\circ\text{C}</math>, <math>V_{\text{jet}} = 2.5</math> m/s, <math>N_j = 20</math> rpm, a) Outer TC, <math>\Theta=0^\circ</math>. b) Outer TC, <math>\Theta=90^\circ</math>. c) Outer TC, <math>\Theta=180^\circ</math>.....</b>	<b>32</b>
<b>Fig. 4.9,</b>	<b>Effect of number of jets, comparison between No. of jets = 1, 2 and 3. <math>T_{\text{initial}} = 450</math> <math>^\circ\text{C}</math>, <math>\Delta T_{\text{sub}} = 60</math> <math>^\circ\text{C}</math>, <math>V_{\text{jet}} = 2.5</math> m/s, <math>N_j = 20</math> rpm, a) Inner TC, <math>\Theta=0^\circ</math>. b) Inner TC, <math>\Theta=90^\circ</math>. c) Inner TC, <math>\Theta=180^\circ</math>.....</b>	<b>33</b>
<b>Fig. 4.10,</b>	<b>Effect of <math>\Delta T_{\text{sub}}</math>, using fixed jet comparison between <math>\Delta T_{\text{sub}} = 60</math>, 40, and 20 <math>^\circ\text{C}</math>, <math>T_{\text{initial}} = 450</math> <math>^\circ\text{C}</math>, <math>V_{\text{jet}} = 2.5</math> m/s, number of jets = 1. a) Outer TC, <math>\Theta=0^\circ</math>. b) Inner TC, <math>\Theta=0^\circ</math>.....</b>	<b>34</b>

<b>Fig. 4.11,</b>	<b>Effect of <math>\Delta T_{\text{sub}}</math>, using fixed jet comparison between <math>\Delta T_{\text{sub}} = 60</math>, 40, and 20 °C, <math>T_{\text{initial}} = 450</math> °C, <math>V_{\text{jet}} = 2.5</math> m/s, number of jets =1. a) Outer TC, <math>\Theta = 90^\circ</math>. b) Inner TC, <math>\Theta = 90^\circ</math>.....</b>	<b>35</b>
<b>Fig. 4.12,</b>	<b>Effect of <math>\Delta T_{\text{sub}}</math>, using fixed jet comparison between <math>\Delta T_{\text{sub}} = 60</math>, 40, and 20 °C, <math>T_{\text{initial}} = 450</math> °C, <math>V_{\text{jet}} = 2.5</math> m/s, number of jets =1. a) Outer TC, <math>\Theta = 180^\circ</math>. b) Inner TC, <math>\Theta = 180^\circ</math>.....</b>	<b>36</b>
<b>Fig. 4.13,</b>	<b>Effect of <math>\Delta T_{\text{sub}}</math>, using fixed jets comparison between <math>\Delta T_{\text{sub}} = 60</math>, 40, and 20 °C, <math>T_{\text{initial}} = 450</math> °C, <math>V_{\text{jet}} = 2.5</math> m/s, number of jets =2. a) Outer TC, <math>\Theta = 180^\circ</math>. b) Inner TC, <math>\Theta = 180^\circ</math>.....</b>	<b>37</b>
<b>Fig. 4.14</b>	<b>Effect of jet rotation speed <math>N_j</math>, comparison between <math>N_j = 0, 20, 40</math> and 60 RPM. <math>T_{\text{initial}} = 450</math> °C, <math>\Delta T_{\text{sub}} = 60</math> °C, <math>V_{\text{jet}} = 2.5</math> m/s, No. of jets = 1 jet a) Outer TC, <math>\Theta = 0^\circ</math>. b) Outer TC, <math>\Theta = 30^\circ</math>. c) Outer TC, <math>\Theta = 90^\circ</math>.....</b>	<b>39</b>
<b>Fig. 4.15</b>	<b>Effect of jet rotation speed <math>N_j</math>, comparison between <math>N_j = 0, 20, 40</math> and 60 RPM. <math>T_{\text{initial}} = 450</math> °C, <math>\Delta T_{\text{sub}} = 60</math> °C, <math>V_{\text{jet}} = 2.5</math> m/s, No. of jets = 1 jet a) Outer TC, <math>\Theta = 120^\circ</math>. b) Outer TC, <math>\Theta = 150^\circ</math>. c) Outer TC, <math>\Theta = 180^\circ</math>.....</b>	<b>40</b>
<b>Fig. 4.16</b>	<b>Effect of jet rotation speed <math>N_j</math>, comparison between <math>N_j = 0, 20, 40</math> and 60 RPM. <math>T_{\text{initial}} = 450</math> °C, <math>\Delta T_{\text{sub}} = 60</math> °C, <math>V_{\text{jet}} = 2.5</math> m/s, No. of jets = 1 jet a) Inner TC, <math>\Theta = 0^\circ</math>. b) Inner TC, <math>\Theta = 90^\circ</math>. c) Inner TC, <math>\Theta = 180^\circ</math>.....</b>	<b>41</b>
<b>Fig. 4.17</b>	<b>Effect of jet rotation speed <math>N_j</math>, comparison between <math>N_j = 0, 20, 40</math> and 60 RPM. <math>T_{\text{initial}} = 450</math> °C, <math>\Delta T_{\text{sub}} = 80</math> °C, <math>V_{\text{jet}} = 2.5</math> m/s, No. of jets = 1 jet a) Outer TC, <math>\Theta = 0^\circ</math>. b) Outer TC, <math>\Theta = 30^\circ</math>. c) Outer TC, <math>\Theta = 90^\circ</math>.....</b>	<b>43</b>
<b>Fig. 4.18</b>	<b>Effect of jet rotation speed <math>N_j</math>, comparison between <math>N_j = 0, 20, 40</math> and 60 RPM. <math>T_{\text{initial}} = 450</math> °C, <math>\Delta T_{\text{sub}} = 80</math> °C, <math>V_{\text{jet}} = 2.5</math> m/s, No. of jets = 1 jet a) Outer TC, <math>\Theta = 120^\circ</math>. b) Outer TC, <math>\Theta = 150^\circ</math>. c) Outer TC, <math>\Theta = 180^\circ</math>.....</b>	<b>44</b>
<b>Fig. 4.19</b>	<b>Effect of jet rotation speed <math>N_j</math>, comparison between <math>N_j = 0, 20, 40</math> and 60 RPM. <math>T_{\text{initial}} = 450</math> °C, <math>\Delta T_{\text{sub}} = 80</math> °C, <math>V_{\text{jet}} = 2.5</math> m/s, No. of</b>	

	jets = 1 jet a) Inner TC, $\Theta=0^\circ$ . b) Inner TC, $\Theta=90^\circ$ . c) Inner TC, $\Theta=180^\circ$ .....	45
Fig. 4.20	Effect of jet rotation speed $N_j$ , comparison between $N_j= 0, 20, 40$ and $60$ RPM. $T_{\text{initial}}= 450^\circ\text{C}$ , $\Delta T_{\text{sub}}= 80^\circ\text{C}$ , $V_{\text{jet}}= 2.5$ m/s, No. of jets = 2 jets a) Outer TC, $\Theta=0^\circ$ . b) Outer TC, $\Theta=90^\circ$ . c) Outer TC, $\Theta=180^\circ$ .....	47
Fig. 4.21	Effect of jet rotation speed $N_j$ , comparison between $N_j= 0, 20, 40$ and $60$ RPM. $T_{\text{initial}}= 450^\circ\text{C}$ , $\Delta T_{\text{sub}}= 80^\circ\text{C}$ , $V_{\text{jet}}= 2.5$ m/s, No. of jets = 2 jets a) Inner TC, $\Theta=0^\circ$ . b) Inner TC, $\Theta=90^\circ$ . c) Inner TC, $\Theta=180^\circ$ .....	48
Fig. 4.22	Effect of jet rotation speed $N_j$ , comparison between $N_j= 0, 20, 40$ and $60$ RPM. $T_{\text{initial}}= 450^\circ\text{C}$ , $\Delta T_{\text{sub}}= 80^\circ\text{C}$ , $V_{\text{jet}}= 2.5$ m/s, No. of jets = 3 jets a) Outer TC, $\Theta= 0^\circ$ . b) Outer TC, $\Theta=90^\circ$ . c) Outer TC, $\Theta=180^\circ$ .....	50
Fig. 4.23	Effect of jet rotation speed $N_j$ , comparison between $N_j= 0, 20, 40$ and $60$ RPM. $T_{\text{initial}}= 450^\circ\text{C}$ , $\Delta T_{\text{sub}}= 60^\circ\text{C}$ , $V_{\text{jet}}= 2.5$ m/s, No. of jets = 3 jet a) Inner TC, $\Theta=0^\circ$ . b) Inner TC, $\Theta=90^\circ$ . c) Inner TC, $\Theta=180^\circ$ .....	51
Fig. 4.24	The behavior of surface temperature of the cylinder at different angles from the stagnation point ( $\Theta=0^\circ$ ) while acting with single fixed jet.....	52
Fig. 4.25	The behavior of surface temperature of the cylinder at different angles from the stagnation point ( $\Theta=0^\circ$ ) while acting with single rotating jet.....	53
Fig. 4.26	The temperature variation at different angles from the stagnation point ( $\Theta=0^\circ$ ) at different time (t) using single jet , $T_{\text{initial}}= 450^\circ\text{C}$ , $\Delta T_{\text{sub}}= 60^\circ\text{C}$ , $V_{\text{jet}}= 2.5$ m/s, comparison between $N_j= 0, 20, 40$ and $60$ rpm , a ) t = 5 sec , b ) t = 10 sec. c ) t = 20 sec .....	55
Fig. 4.27	The temperature variation at different angles from the stagnation point ( $\Theta=0^\circ$ ) at different time (t) using single jet , $T_{\text{initial}}= 450^\circ\text{C}$ , $\Delta T_{\text{sub}}= 60^\circ\text{C}$ , $V_{\text{jet}}= 2.5$ m/s, comparison between	

	$N_j = 0, 20, 40$ and $60$ rpm , a ) $t = 30$ sec , b ) $t = 40$ sec. c ) $t = 50$ sec .....	56
<b>Fig. 4.28</b>	The temperature variation at different angles from the stagnation point ( $\Theta=0^\circ$ ) at different time (t) using single jet , $T_{\text{initial}}= 450^\circ\text{C}$ , $\Delta T_{\text{sub}}= 80^\circ\text{C}$ , $V_{\text{jet}}= 2.5$ m/s, comparison between $N_j= 0, 20, 40$ and $60$ rpm , a ) $t = 5$ sec , b ) $t = 10$ sec c ) $t = 20$ sec .....	57
<b>Fig. 4.29</b>	The temperature variation at different angles from the stagnation point ( $\Theta=0^\circ$ ) at different time (t) using single jet , $T_{\text{initial}}= 450^\circ\text{C}$ , $\Delta T_{\text{sub}}= 80^\circ\text{C}$ , $V_{\text{jet}}= 2.5$ m/s, comparison between $N_j = 0, 20, 40$ and $60$ rpm , a ) $t = 30$ sec , b ) $t = 40$ sec c ) $t = 50$ sec .....	58
<b>Fig. 4.30</b>	The behavior of surface temperature of the cylinder at different angles from the stagnation point ( $\Theta=0^\circ$ ) while acting with double fixed jets.....	59
<b>Fig. 4.31</b>	The behavior of surface temperature of the cylinder at different angles from the stagnation point ( $\Theta=0^\circ$ ) while acting with double rotating jets.....	60
<b>Fig. 4.32</b>	The temperature variation at different angles from the stagnation point ( $\Theta=0^\circ$ ) at different time (t) using double jets , $T_{\text{initial}}= 450^\circ\text{C}$ , $\Delta T_{\text{sub}}= 80^\circ\text{C}$ , $V_{\text{jet}}= 2.5$ m/s, comparison between $N_j = 0, 20, 40$ and $60$ rpm , a ) $t = 5$ sec , b ) $t = 10$ sec c ) $t = 20$ sec .....	62
<b>Fig. 4.33</b>	The temperature variation at different angles from the stagnation point ( $\Theta=0^\circ$ ) at different time (t) using double jets , $T_{\text{initial}} = 450^\circ\text{C}$ , $\Delta T_{\text{sub}} = 80^\circ\text{C}$ , $V_{\text{jet}}= 2.5$ m/s, comparison between $N_j= 0, 20, 40$ and $60$ rpm , a ) $t = 30$ sec , b ) $t = 40$ sec c ) $t = 50$ sec .....	63
<b>Fig. 4.34</b>	The behavior of surface temperature of the cylinder at different angles from the stagnation point ( $\Theta=0^\circ$ ) while acting with triple fixed jets.....	64