CHAPTER 5

CONCLUSION

5.1 SUMMARY OF THE RESEARCH FINDINGS

The summary of the research findings in the present work during turning and milling operation are given below.

5.1.1 Turning Operation

The Taguchi optimization method is successfully used to identify the optimal cutting parameters of 4A and 5A grade DSS during dry and wet turning operations. The following conclusions are made from this work.

A cutting speed of 100 m/min and a feed rate of 0.04 mm/rev are found to give the lowest surface roughness for 5A and 4A grade DSS during dry and wet turning operation. A cutting speed of 120 m/min and a feed rate of 0.04 mm/rev are found to give the lowest cutting force for 5A and 4A grade DSS. A cutting speed of 80 m/min and a feed rate of 0.04 mm/rev are found to give the lowest tool wear for 5A and 4A grade DSS.

ANOVA analysis indicates that for dry turning operation, the feed rate and the cutting speed affect the surface roughness of 5A grade DSS by approximately 64% and 31%, respectively. The feed rate and the cutting speed affect the cutting force of 5A grade DSS by approximately 53% and 45%, respectively. The cutting speed and the feed rate affect the tool wear of 5A grade DSS by approximately 92% and 7%, respectively.
ANOVA analysis indicates that for dry turning operation, the feed rate and the cutting speed affect the surface roughness of 4A grade DSS by about 63% and 31%, respectively. The feed rate and the cutting speed affect the cutting force of 4A grade DSS by about 56% and 42%, respectively. The cutting speed and the feed rate affect the tool wear of 4A grade DSS by about 91% and 9%, respectively.

ANOVA analysis indicates that for wet turning operation, the feed rate and the cutting speed affect the surface roughness of 5A grade DSS by approximately 59% and 39%, respectively. The feed rate and the cutting speed affect the cutting force of 5A grade DSS by approximately 61% and 39%, respectively. The cutting speed and the feed rate affect the tool wear of 5A grade DSS by approximately 91% and 8%, respectively.

The tool wear is due to abrasion at lower cutting speeds and due to diffusion, thermal softening and notching at higher cutting speeds during dry turning operation. The surface roughness, cutting force and tool wear values for 4A grade DSS are lower compared to 5A grade DSS due to the difference in chemical compositions, which leads to the difference in the formation of micro grains. The surface roughness, the cutting force and the tool wear values of wet turning operation are reduced by about 3-11%, 7-16% and 9-15%, respectively compared to the dry turning operation.
In case of three factor experiment, a cutting speed of 100 m/min, a feed rate of 0.04 mm/rev and a depth of cut of 0.4 mm are found to give the lowest surface roughness for 5A grade DSS during dry turning operation. ANOVA results indicate that for dry turning of 5A grade DSS, the feed rate, the cutting speed and the depth of cut are affecting the surface roughness by about 61%, 26% and 18%, respectively.

5.1.2 Milling Operation

The Taguchi optimization method is successfully used to identify the optimal cutting parameters of 4A and 5A grade DSS during dry and wet milling operations. The following conclusions are made from this work.

A spindle speed of 1000 rpm and a feed rate of 63 mm/min are found to give the lowest surface roughness and cutting force for 5A and 4A grade DSS during dry and wet milling operations. A spindle speed of 500 rpm and a feed rate of 63 mm/min are found to give the lowest tool wear for 5A and 4A grade DSS.

ANOVA analysis indicates that for dry milling operation, the feed rate and the spindle speed affect the surface roughness of 5A grade DSS by approximately 65% and 31%, respectively. The feed rate and the spindle speed affect the cutting force of 5A grade DSS by approximately 60% and 37%, respectively. The spindle speed and the feed rate affect the tool wear of 5A grade DSS by approximately 88% and 10%, respectively.

ANOVA analysis indicates that for dry milling operation, the feed rate and the spindle speed affect the surface roughness of 4A grade DSS by about 78% and 19%, respectively. The feed rate and the spindle speed affect the cutting force of 4A grade DSS by about 74% and 23%, respectively. The
spindle speed and the feed rate affect the tool wear of 4A grade DSS by about 83% and 16%, respectively.

ANOVA analysis indicates that for wet milling operation, the feed rate and the spindle speed affect the surface roughness of 5A grade DSS by approximately 60% and 36%, respectively. The feed rate and the spindle speed affect the cutting force of 5A grade DSS by approximately 66% and 31%, respectively. The spindle speed and the feed rate affect the tool wear of 5A grade DSS by approximately 88% and 10%, respectively.

ANOVA analysis indicates that for wet milling operation, the feed rate and the spindle speed affect the surface roughness of 4A grade DSS by about 75% and 23%, respectively. The feed rate and the spindle speed affect the cutting force of 4A grade DSS by about 77% and 21%, respectively. The spindle speed and the feed rate affect the tool wear of 4A grade DSS by about 83% and 15%, respectively.

The surface roughness, the cutting force and the tool wear values of wet milling operation are reduced by about 5-12%, 8-15% and 9-30%, respectively compared to the dry milling operation.

The BBD-RSM method is used to develop a mathematical model for predicting the surface roughness of 4A grade DSS in terms of the spindle speed, the feed rate and the axial depth of cut. The main effects of spindle speed, feed rate and depth of cut are more significant. The optimal surface roughness is obtained when the spindle speed is kept at 1000 rpm, the feed rate at 40 mm/min and the axial depth of cut at 0.4 mm. The predicted results are compared with results from confirmation tests and the error is within the range of 3-5%.
5.2 SCOPE FOR FUTURE WORK

The intensive research work of DSS alloys related to machining can be extended in the following areas.

1. Machining studies can be extended for rolled and forged DSS to investigate the machining characteristics.

2. Machining studies of DSS can be extended by using minimal fluid application method.

3. The influence of tool angles and coatings on machining performance of DSS can be studied.

4. Surface roughness, cutting force and tool wear of DSS in terms machining parameters can be predicted using artificial neural networks (ANN) and genetic algorithm (GA) methods.