CHAPTER 6

CONCLUSION

6.1 INTRODUCTION

This chapter gives the summary of the work carried out in the present study. The main features of the present work are brought out in the first section. The major conclusions drawn from the results of the theoretical and experimental studies are given in the next section. The scope for future work is presented in the final section.

6.2 SUMMARY OF THE PRESENT RESEARCH WORK

In the present work, wear performance studies on fabricated AlMMCs are carried out. The quality of fabricated composites is verified by analyzing the distribution of particles, density and micro hardness. The effect of heat treatment of fabricated composites has been studied by micro hardness enactment. The effect of reinforcement type, volume fraction, particle size, applied load, sliding speed, sliding distance and abrasive mesh size on wear rate and coefficient of friction is studied in the present study. The effect of these variables on wear mechanism of worn out surfaces in AlMMCs is also studied simultaneously. The studies are conducted for a conventional sliding condition using EN32 steel disc and abrasive paper glued disc. The Pin-on-Disc wear test rig was used for conducting the wear experiments.
Second order quadratic models have been developed for wear rate and coefficient of friction using response surface methodology and considering the linear, square and interaction effects. The adequacy of the developed models has been checked using the analysis of variance. The terms found to be non-significant are excluded from the developed models. The models developed are found to be adequate at 95% confidence level. The adequacy of the models also checked with the help of predicted values versus actual values. The developed models in this work can be reliably used for the prediction of output parameters for the given input parameters.

Adaptive neuro fuzzy inference system models have been developed for the wear rate and coefficient of friction for predicting the output responses for the input process variables. The comparative study has been done on the predicted results of the developed models with experimental results. The results of predicted values are validated with conformation experiments.

6.3 MAJOR CONCLUSIONS

The major conclusions drawn from the present investigation is presented below:

- Aluminium metal matrix composites with all combination of volume fraction and particle sizes were fabricated successfully by stir casting process and fabricated composites are heat treated.
- The microstructure studies revealed the uniform distribution of the particles in the matrix.
- The effect of heat treatment on micro hardness is analyzed and it was found improved 17.97, 16.90 and 16.17 % for Al/SiC,
Al/Zircon and Al/Garnet MMCs respectively than their as-cast composite fabricated with 15% volume fraction and 105 µm particle size.

- The micro hardness of the Al/SiC, Al/Zircon and Al/Garnet MMCs are found to be increased 86.53, 65.38 and 61.53 % respectively with increasing volume fraction from 5 to 25% at 105µm particle size.

- The wear resistance of the composites are higher, further the reinforcements contributed significantly in improving the wear resistance for all composites sliding on steel and abrasive paper glued disc.

- The wear rate of the Al/SiC, Al/Zircon and Al/Garnet MMCs are found to be decreased 59.95, 46.92 and 40.04 % respectively with increasing volume fraction from 5 to 25% at sliding on steel disc, 105 µm particle size, 58.86 N applied load, 1.5 m/s speed and 1.5 km sliding distance. Similarly decrease in wear rate are found 43.82, 32.52 and 17.02 % at sliding on abrasive paper glued disc, 105 µm particle size, 19.62 N applied load, 0.6 m/s speed and 180 abrasive mesh size.

- From the experimental results it is to be noted that Al/Zircon MMCs fabricated with 15% volume fraction and 105 µm particle size exhibit superior wear resistances than Al/SiC MMC at sliding on steel disc, 58.86 N applied load, 1.5 m/s sliding speed and 1.5 km sliding distance. Hence at above condition Al/Zircon MMCs may be considered as a good replacement for Al/MMCs. However, based on the overall performance Al/SiC MMCs exhibits superior mechanical and tribological properties.
The detailed SEM image analysis was done on worn out surfaces of composites for characterizing wear mechanism. The abrasive, adhesive and plastic deformation are found to be a predominant wear mechanism in sliding on steel disc and abrasive wear and pull out of particle is a predominant wear mechanism in sliding on abrasive paper glued disc.

Regression modeling techniques are used to develop empirical relations. The adequacy of the regression models are checked using $R$-squared values which is almost equal to unity. The correlation values nearly equal to one indicates that the models have good prediction accuracy All the models are found to be adequate at 95% confidence levels.

ANFIS model was developed with various membership functions and is iterated for different number of epochs. It is found that the average error is less than 10% and $R$-squared values are almost equal to unity but greater than that of regression models.

6.4 **SCOPE FOR FURTHER RESEARCH WORK**

1. The number of wear parameters can be extended and hence, the database can be improved by extensive experimentation.

2. The experimental work can be extended to other composite materials.

3. The experiment work can be studied with the effect of different wear testing condition like high temperature and lubrication etc.

4. The experiment can be replicated with other different reinforcements materials.