CHAPTER-9

CONCLUSIONS

This research has been conducted with the aim of studying the processing, characterization and machining response of AA7075/SiC composites. The following conclusions are made based on research work.

9.1 CONCLUSIONS

1. The stir casting method was found to be successful to fabricate 7075 Al alloy and Composite 1 [AA7075/10 wt% SiC(10-20µm)], Composite 2 [AA7075/15 wt% SiC(10-20µm)], Composite 3 [AA7075/10 wt% SiC (20-40µm)] and Composite 4 [AA7075/15 wt% SiC (20-40µm)].

2. The soundness of casting is affected by reinforcement content, its distribution, the level of intimate contact of the wetting with matrix material and by the porosity content. Therefore, by controlling the processing conditions as well as the relative amount of the SiC particles (reinforcing material), AA7075/ SiC composites (1, 2, 3 and 4) with improved mechanical properties were obtained.

3. Magnesium (Mg) in elemental form is added to enhance wettability between 7075Al alloy and SiC particles. SiC particles are found intact and no Oxidation of SiC has occurred.

4. SEM examination of AA7075/ SiC composites (1, 2, 3 and 4) produced under optimum conditions shows that distribution of SiC particles (reinforcement) is homogeneous. Products for secondary chemical reactions on the SiCp/matrix interface were not observed.
5. The XRD analysis of AA7075/10 wt% SiC(10-20µm), AA7075/15 wt% SiC(10-20µm), AA7075/10 wt% SiC (20-40µm) and AA7075/15 wt% SiC (20-40µm) composites reveal no discernible peaks of Al₄C₃.

6. EPMA analysis indicated that aluminum is the main constituent in the AA7075/SiCp composites (1, 2, 3 and 4). It gave atomic percentage of different elements in the samples. It also indicated that elements are properly distributed throughout the composites.

7. Decomposition step in DTG curve is seen at temperature of 1257 °C, 1210 °C and 1256 °C respectively for 7075 Al alloy, AA7075/10wt%/SiCp (20-40µ) and AA7075/15wt%/SiCp (20-40µ) composites. In DTA curves of 7075 Al alloy, 10 wt % and 15 wt % SiC composites, one endothermic peak and one exothermic peak have been noticed.

8. Surface roughness of AA7075/SiC composites during turning by tungsten carbide inserts increases with increase in weight fraction and size of SiC particles. Maximum surface roughness is noticed for AA7075/15wt%/SiCp (20-40µm) composite and minimum for AA7075/10wt%/SiCp (10-20µm).

9. Cutting forces (Tangential force, feed force and radial force) increase with increase in weight fraction and size of SiC particles. The AA7075/15wt%/SiCp (20-40µm) composite experience maximum cutting forces.

10. Maximum power was found to be consumed during turning of AA7075/15wt%/SiCp (20-40µm) composite and minimum during turning of AA7075/10wt%/SiCp (10-20µm) composite.
11. Tools wear increases with increase in weight fraction and size of SiC particles. Tool (tungsten carbide inserts) wear is the maximum during turning of AA7075/15wt%/SiCp (20-40µm) composite and minimum during turning of AA7075/10wt%/SiCp (10-20µm) composite.

12. Tool life of Tungsten carbide inserts is the maximum when turning AA7075/15 wt%/SiCp (10-20µm) composite and minimum when turning AA7075/15wt%/SiCp (20-40µm) composite.

13. A regression model that relates surface roughness, tangential force, feed force, radial force, power consumption, flank wear, crater wear and tool life with the process parameters (cutting conditions) was developed. It is observed that in most of the cases cutting speed, feed, depth of cut and nose radius are significant parameters.

14. Validation of regression model shows that experimental data and data obtained by regression equation are closely correlated to each other.

15. Single objective optimizations of process parameters (cutting conditions) were done by desirability analysis. Optimum values of cutting speed, feed, depth of cut and nose radius were found out to individually minimize surface roughness, tangential force, feed force, radial force, power consumption, flank wear, crater wear and to maximize tool life.

16. Multi objective optimization of machining parameters was done by desirability analysis. Optimum values of cutting speed, feed, depth of cut and nose radius were found out to simultaneously minimize surface roughness, tangential force, feed force, radial force, power consumption, flank wear, crater wear and to maximize tool life.
17. In the undertaken work four multi objective optimization models have been developed. The solutions (optimum cutting conditions) suggested by these models are for specific objectives. These are to be adopted for diverse industrial requirements.

18. GA tool box was used to find optimum values of cutting speed, feed, depth of cut and nose radius to individually minimize surface roughness, tangential force, feed force, radial force, power consumption, flank wear, crater wear and to maximize tool life.

19. Optimum values of process parameters (cutting conditions) obtained by desirability analysis and GA tool box are also in close agreement.

20. Experimental validation of results shows that values of responses obtained by turning at optimum cutting conditions are close to response values obtained at these cutting conditions.

21. Recommendations for turning of AA7075/10wt%SiC (10-20µm), AA7075/15wt%SiC (10-20 µm), AA7075/10wt% SiC (20-40 µm) and AA7075/15wt% SiC (20-40 µm) composites.
   a) Initial turning is to be done by a tool fabricated locally, by brazing of carbide insert on mild steel rod on a Lathe Machine.
   b) Subsequent turning is to be carried out on CNC by Tungsten carbide inserts CNMG120404 EM, CNMG120408 EM, CNMG120412 EM, of grade 6615, at optimum cutting conditions indicated in chapter 7.

9.2 SCOPE FOR FURTHER WORK

Researchers are interested to develop the materials which are light in weight, have high stiffness, fracture toughness and offer good wear resistance. This can be achieved by
reinforcement of aluminium alloy with harder particles like Al$_2$O$_3$, SiO$_2$ etc. The properties of the final component can be tailored based on specific requirements. This can be done by using different size and weight fraction of reinforcement particles. Due to this fundamental reason, metal matrix composites (MMC) are gaining acceptance. Hence, there exists a considerable scope in carrying out research in this area.

Limited research has been conducted on machining behavior of metal matrix composites. A number of problems during the machining of MMC still need solution. Some of them are:

i. Identification of specific tool for particular MMC.

ii. Investigation about the optimum values of cutting parameters.

iii. Cost effective selection of tools.

iv. Balance in the values of conflicting responses during machining of MMCs.