9. Conclusions and Suggestions of Future Work

9.1. Conclusions

The effect of through thickness anisotropy on the ballistic behaviour of a 70 mm thick AA 7017 plate has been investigated. Studies have also been carried out to understand the ballistic behaviour along three principal directions of the 70 mm thick AA 7017 plate. The ballistic behaviour of AA 7017 alloy has been further analysed under different heat-treated conditions against hard steel and lead projectilesas a part of this doctoral thesis. In addition, the ballistic behaviour of AA 7017 alloy has been compared with five other commercially available aluminium alloys used for armour application. The details have been presented in chapters 3-8. Conclusions drawn from these investigations are summerised below:

1. There is a difference in microstructure and texture at surface and centre of the AA 7017 plate, which induces the anisotropy of the mechanical properties. The weak texture at surface facilitates the material to absorb the projectile impact energy efficiently and it has led to a better ballistic behaviour of the material. At the same time, strong texture at the centre of the plate assists the formation of easy adiabatic shear bands (ASBs) and a poor ballistic behaviour.

2. Microstructure and texture play a vital role in the ballistic performance of the AA 7017 alloy plate. The grain boundary regions promote strain localization and a strong texture inhibits the uniform dissipation of impact energy. As a result, the best ballistic performance is observed in short transverse (ST) direction of the AA 7017 plate owing to the presence of less number of grain boundaries and a weak crystallographic texture.

3. The AA 7017 alloy displays highest strength and hardness at peak-aged (PA) condition due to a fine distribution of G.P. zones and η′ precipitates. Strength and hardness appear to be more critical aspect for ballistic performance in AA7017 than ductility and impact toughness against small caliber projectiles. Consequently, the PA plates demonstrate the best ballistic performance among the heat treated plated against 7.62mm lead as well as high hardness projectiles.

4. Ballistic penetration resistance of the studied aluminium alloys against soft steel as well as high hardness steel projectiles is in agreement with their strength and hardness values. The AA 7017 alloy has shown the best ballistic performance among the studied materials due to its high strength and hardness values. Further, it is a very good candidate material for armour applications against small caliber ammunition.

9.2. Suggestions for future work

1. Thermo-mechanical processing can be fine-tuned to reduce the through thickness anisotropy in AA 7017 plate and improve its ballistic efficiency. It has been suggested based on the observations made in chapters 3 and 4.

2. In armour research, it is essential to find out the critical thickness of plate required to stop a given projectile. Studies should be carried out to find out the critical thickness of AA 7017 alloy against different small caliber ammunitions.

3. Armour plates are used at different angles in the combat vehicles to enhance their ballistic protection. The behaviuor of AA 7017 material at different angles of attacks should be investigated.

4. In the present thesis, the ballistic behavior of the material has been correlated with the static mechanical properties of the studied aluminium alloys. However, the dynamic properties of the material can describe the ballistic behavior in a more efficient manner. Further studies should be carried out to evaluate the dynamic properties using Split Hopkinson Pressure Bar and associate the results with ballistic performance of AA 7017.