CHAPTER 9

CONCLUSION

The importance of piston in automotive system with its terminology is clearly described. The detailed explanation is given on the history of the piston with keen concentration on type of piston materials and the selection of suitable piston materials. The methodology behind the fabrication process of piston by die casting method with a flow chart is explained. The need for such bimetallic piston is realized. Though literature available on this topic is scarce, a thorough literature search has been made and the ideas of patents are also discussed.

The need for improvement of properties by heat treatment is realized through the metallurgical and mechanical characterization studies of treated and untreated pistons. Pistons are subjected to heat treatments and analyzed through SEM study for their bonding nature. XRD study reveals the phases. Hardness and shear strength data reveal the mechanical characteristics of pistons. For comparison, similar tests are carried out on as cast specimens and heat treatment specimens under various conditions. From this, the following results are obtained

- Air treated pistons exhibit
  - Better bonding
  - Fair hardness
  - Shear strength of 177 Mpa

- Water quenched pistons exhibit
  - Cracks at the bonding zone
  - Very high hardness
  - Shear strength of 220 Mpa.
Because of the high hardness and presence of cracks at the aluminum zone, water quenched heat treatment is not recommended.

Importance of usage of single tool to machine the Al-CI bonding region is explained. Such an innovative idea of using a single tool for machining bimetal not only reduces the cycle time but also improves the productivity. The cutting force measurement on 1½ minutes dipped insert is carried out and machining parameters are optimized.

The influences of cutting force on different time dipped in condition inserts are studied. Based on Taguchi’s robust design the optimum machining condition for each case is identified. From the force chart, it is observed that the dipping time plays vital role on cutting force. There is no significant change on cutting force even if the dipped time is extended beyond 2 minutes. As far as the bonding nature is concerned, the 2 minutes dipped in condition withstands more force and hence it is identified as better dipped in condition. The same is also verified with push out test. Low speed, high feed and larger depth of cut result the highest cutting force.

For all the machining conditions employed, surface roughness found to be within the limit proposed by the industry standard. Feed plays a major role in achieving smoother finish. It is observed that the crater wear occurs on CBN tool.

When the output of the developed mathematical model is compared with the experimental values, suitability of the model for predicting the cutting force is also assessed. Genetic Algorithm (GA) is
developed using MATLAB 7. The outputs of GA (the optimized value) are compared with the outputs of Taguchi’s method.

The close agreement with the predicted and experimental values of cutting force confirms the potential applicability of developed model.

From this research work, the following conclusions are derived:

- CBN tool can also be used to machine the bimetallic area.
- Air quenching treatment is highly recommended for better strength.
- The optimal cutting conditions for such bimetallic pistons are obtained by using Taguchi’s method.
- From the ANOVA analysis, it is observed that the depth of cut and feed rate are the most significant parameters which affect the cutting force.
- Insert with 2 minutes dipped in condition exhibits more strength, and no significant effect on cutting force is observed, even if it is dipped beyond 2 minutes.
- The developed mathematical model for cutting force is useful in predicting cutting force at the bonding zone.
- The optimal results obtained through Taguchi’s are comparable with the results obtained through GA.
- Through the surface roughness and the bond checking testing, the surface integrity of the machined pistons is evaluated. For all the chosen levels of parameters, the machined pistons exhibit good surface integrity.