CHAPTER 9
CONCLUSIONS

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- Surface milling of hardened AISI4340 steel with minimal pulsed jet fluid application has been investigated in depth and its performance is evaluated on the basis of surface finish, flank wear and cutting force.
- Surface roughness (Ra) value substantially reduced from 1.177 microns to 0.411 microns i.e., 65% improvement in surface finish with the use of the minimal cutting fluid application technique where the rate of fluid application was as low as 5 to 6.7 ml/min, when compared to conventional wet milling which needs thousands of litres of cutting fluid.
- Flank wear reduced from 0.051 mm to 0.014 mm i.e., 72% reduction in flank wear and cutting force reduced from 228.25 N to 94.79 N i.e., 58.47% reduction in cutting force during minimal fluid application due to excellent lubrication when compared to conventional wet milling under the same cutting conditions.
- Delivery parameters for fluid application were investigated and optimum conditions arrived at on the basis of cutting performance.
- An investigative comparison with dry and conventional wet milling under same conditions has been done to evaluate the relative performance of hard milling with minimal fluid application.
- Effect of a semisolid lubricant (silicon grease) as a cutting performance enhancer during hard milling with minimal fluid application was also investigated and it was found that the presence of semisolid lubricant during minimal fluid application improved cutting performance marginally.
- An attempt was made to provide an explanation for the results obtained on the basis of chemical, physical and thermal phenomena in metal cutting.
- The newly developed process namely hard milling with minimal fluid application in its optimized form has been found to give superior performance compared to pure dry milling and conventional wet milling.
- The new scheme will be well acceptable to the industry as it does not require any major changes in the existing setup for its implementation on the shop floor and is
totally free from problems associated with procurement, storage and disposal of cutting fluid.

- An attempt was made to develop a model based on artificial neural network to simulate hard milling with minimal fluid application and the predictions of the model matched well with the experimental results. Such a model can play a good role during computer control of fluid application parameters.

### 9.2 SCOPE FOR FUTURE WORK

- A vegetable oil based cutting fluid may be developed for milling of hardened AISI4340 steel under minimal fluid application scheme which will make the process more environment friendly.
- Minimal fluid application schemes can be developed for other tool-work combinations during surface milling which can serve as a database for industries willing to implement this scheme.
- The surface finish of the machined component primarily depends upon the amount of average principal flank wear ($V_B$). An increase in the amount of average principal flank wear ($V_B$) leads to reduction in nose radius of the cutting insert which in turn reduces the surface quality along the job axis. Another tool wear criteria is average auxiliary flank wear which also governs the surface finish on the job as well as dimensional accuracy. Irregular and higher auxiliary flank wear leads to poor surface finish and dimensional inaccuracy (Syed and Dhar, 2010). It is expected that one of the reasons for improvement in surface finish during hard milling with minimal fluid application is due to the reduction in average auxiliary flank wear as in the case of MQL turning. Hence more experiments can be conducted to prove the effect of average auxiliary flank wear on surface finish.
- Similar work can be extended for different work-tool combinations.