CHAPTER-5

CONCLUSION AND SCOPE FOR FUTURE WORK

5.1 Conclusions

The commercial A319 and A356 aluminum alloy castings prepared under stationary and oscillatory conditions. Metallurgical and mechanical properties of A319 and A356 aluminum alloy casting solidified under stationary and oscillatory conditions were measured. In metallurgical properties, the average grain size of a-Al, dendrite arm spacing, and morphological properties of Si-particles have been discussed, whereas mechanical properties: yield strength, ultimate tensile strength, percentage elongation, and microhardness have been taken up .The salient conclusions from the present investigation are summarized as follows:

1. Both strength and elongation improved in oscillatory prepared casting as compared to that of stationary casting.

2. In general, the strength of the alloy is improved by changing chemical composition, but in the present study, the strength is improved without changing chemical composition.

3. The hardness of casting surface improved because of high cooling rate (due to mold oscillation) as compared to stationary casting.

4. After application of oscillations during the solidification, both acicular silicon and large grains are fractured into fine grains.

5. Average area and average length of silicon particle in alloy under vibratory condition decrease with the increase in frequency of vibration of mold. Aspect ratio and roundness of silicon particle increases with increase in frequency of vibration

6. The SEM–EDS analysis shows mixed intermetallic phases.

7. As per the analysis according to the fracture mode via tensile test, it can be concluded that the fractrography of nonvibrated casting reveals a huge portion of brightly reflecting cleavage facets and some secondary cracks are also visible in fractography micrograph.

8. The SEM image of a tensile fractured surface of vibratory casting reveals that the fracture mode is mixed. It shows dimples with bright cleavage facets in the aluminum matrix. The presence of dimples and facets shows quasi-cleavage fracture.

9. Ultimate tensile strength of casting prepared under oscillatory conditions improves as compared to that of stationary prepared casting. The maximum increment in UTS is at 400Hz-5µm for both A319 and A356 aluminum alloys. The percentage increase in ultimate tensile strength of A319 and A356 for oscillated test specimens when compared to stationary cast specimens are 39.03 % and 36.75 % at 400Hz-5µm respectively.

10. Yield strength of casting prepared under oscillatory conditions improves as compared to that of stationary prepared castings. The maximum increment in YS is at 400Hz-5µm for both A319 and A356 aluminum alloys. The percentage increases in YS of A319 and A356 for oscillated test specimens when compared to that of stationary cast specimens are 28.07 % and 21.57 % at 400Hz-5µm respectively.

11. Percentage Elongation of casting prepared under oscillatory conditions improves as compared to that of stationary prepared castings. The maximum increment in percentage elongation is at 400Hz-5µm for both A319 and A356 aluminum alloys. The percentage increases in percentage elongation of A319 and A356 for oscillated test specimens when compared to stationary cast specimens are 169.26% and 108.33% at 400Hz-5µm respectively.

12. Micro-hardness of casting prepared under oscillatory conditions improves as compared to that of stationary prepared castings. The maximum increment in Micro-hardness is at 400Hz-5µm for both A319 and A356 aluminum alloys. The percentage increase in micro-hardness of A319 and A356 for oscillated test specimens when compared to stationary cast specimens are 54.95 % and 43 % at 400Hz-5µm respectively.

13. Impact toughness of casting prepared under oscillatory conditions improves as compared to that of stationary prepared castings. The maximum increment in impact toughness is at 400Hz-5µm is for both A319 and A356 aluminum alloys. The percentage increase in impact toughness of A319 and A356 for oscillated test specimens when compared to stationary cast specimens are 175 % and 255% at 400Hz-5µm respectively.

14. The roundness of silicon particles of casting prepared under oscillatory conditions improves as compared to that of stationary prepared castings. The maximum increment in roundness of silicon particles is at 400Hz-5µm for both A319 and A356 aluminum alloys. The percentage increase in the roundness of silicon particles of

A319 and A356 for oscillated test specimens when compared to that of stationary cast specimens are 66.22% and 71.57% at 400Hz-5µm.

15. The average grain size of α-Al of castings prepared under oscillatory conditions improves as compared to stationary prepared castings. The maximum decrement in the average grain size is at 400Hz-5µm for both A319 and A356 aluminum alloys. The percentage decrement in the average grain size of A319 and A356 for oscillated test specimens when compared to that of stationary cast specimens are 39.03% and 36.75 % at 400Hz-5µm respectively.

16. The dendrite arm spacing of casting prepared under oscillatory conditions improve as compared to stationary prepared castings. The maximum decrement in dendrite arm spacing is at 400Hz-5µm for both A319 and A356 aluminum alloys. The percentage decrement in dendrite arm spacing of A319 and A356 for oscillated test specimens when compared to that of stationary cast specimens are 64.84 % and 60.75% at 400Hz-5µm respectively.

5.2 Recommendation for future work

The results documented in the present research are significant and useful in improving metallurgical and mechanical properties of metal castings. It is still suggested that the process development of oscillatory casting is an area wide open to be investigated. However, recommendation for future work includes following:

1. In the research work, A319 alloy and A356 alloy have been studied. Other ferrous and non-ferrous alloys should also be investigated.
2. Effect of pouring temperature on grain refinement and mechanical properties of ferrous and non-ferrous alloys casting should also be investigated.
3. Effects of various cooling media should also be carried out on mechanical properties ferrous and non-ferrous alloys casting should also be investigated.
4. Pressure effects should be carried out on porosity and grain refinement of ferrous and non-ferrous alloys casting.
5. Effects of other mold oscillation parameters such as frequency more than 400Hz and amplitude more than 15µm on the microstructure of die castings.
6. Simulation may be applied for different oscillatory casting.
7. Study the combined effect of mold oscillation and degree of superheat temperature on metallurgical and mechanical properties of ferrous and non-ferrous alloys casting.