7.1 TWIN ROLL CASTING PARAMETERS

7.1.1 When the pouring temperature is 670, 680, 690 and 700 °C the formation of good strips happens at 11, 10, 9 and 8 rpm respectively. Below these range of rpm it is generally observed that there is premature solidification of liquid metal above the roller. This solidified mass acts like a wedge and does not allow rolling process to proceed further.

7.1.2 For liquid metal pouring temperature of 670, 680, 690 and 700 °C, the highest rpm where in the sound strip without defect obtained are at 13, 11, 10 and 9 rpm respectively. In other words there is an inverse relationship between pouring temperature and rpm of the roller and mathematical relationship between temperature and rpm is linear. At higher rpm than that stipulated for given pouring temperature two major defects happen they are; hot tear and hot shear of the strips and in extreme cases intermittent and broken rolled strip formation decreases.

7.1.3 The conclusion 1 and 2 indicates there is a small range of rpm for any given pouring temperature wherein sound strips were obtained. In this range of rpm it was found that for 670, 680, 690 and 700 °C pouring temperature the best tensile strength was obtained for the strip at roller rpm of 12, 10, 10, 9 rpm respectively. This is an inverse relationship between pouring temperature and rpm and the equation is $S = -0.09T + 71.9$. Where $S =$ Roller speed in rpm and $T =$ Temperature in °C.

7.1.4 It is essential to preheat the twin roller to about 150 °C in addition the pouring basin also needs preheating.
7.1.5 For consistent strip formation and for long strip length the vertical twin roll caster is not suitable.

7.1.6 Theoretically and practically it was found that an inclined strip drawing is an essential part of the system. Under this condition it was possible to obtain sound and long strips.

7.2 STRIP PHYSICAL CHARACTERISTICS

7.2.1 At the beginning stages of the strip formation it was found that the strip width was not uniform. This instability of the strip width continues for a strip length of about 100 mm. After this initial stage the strip width of the rolled aluminium alloy remains constant.

7.2.2 The strip width is directly proportional to pouring temperature. If \( W \) is the strip width in mm and \( T \) is pouring temperature in °C then the equation governing the strip width is given below:

\[
W = 0.0537 T - 2.999
\]

There is 22% increase in strip width when the pouring temperature is raised from 670 to 700 °C.

7.2.3 The strip thickness throughout the rolled length of the strip remains inverse proportionality to the roller rpm.

7.2.4 Irrespective of pouring temperature the strip thickness almost remains constant.

7.2.5 It may be noted that closer to the high rpm of the strip many defects sets in. The same is aggravated as the pouring temperature is increased. Some such defects are centerline shrinkage, heat lines and hot tears.

7.3 MECHANICAL PROPERTIES

7.3.1 The Ultimate Tensile Strength was the highest when the rpm 12, 10, 10 and 9. For
pouring temperature of 670, 680, 690 and 700 °C respectively. This indicates both rpm of the roller and pouring temperature in a combined way influence the tensile strength.

7.3.2 The Ultimate Tensile Strength of the rolled strip was the highest under the following condition, pouring temperature 680 °C and speed of rolling 10 rpm.

7.3.3 The percentage elongation of the twin rolled strip for any given poring temperature indicates that it is dependent on rpm through an inverse relationship.

7.3.4 The best percentage elongation value was obtained when the pouring temperature was 670 °C and 11 rpm of the twin roller.

7.3.5 The BHN was not greatly influenced by pouring temperature or liquid metal or roller rpm. The variation was within 3%.

7.4 TWIN ROLLED ALUMINIUM SILICON CARBIDE MMC STRIPS

7.4.1 The matrix material was 2025 aluminium alloy. To this adding 25-35 μm, 15-25 μm, 5-15 μm silicon carbide particulates results in a gradual increase in strip width as quality of silicon carbide is increased.

7.4.2 Irrespective of silicon carbide particle size as well as the amount of silicon carbide in the liquid metal the average strip thickness of the twin rolled aluminium silicon carbide MMC remains constant.

7.4.3 The addition of silicon carbide results in improvement of Ultimate Tensile Strength of twin rolled strip when compared to the matrix alloy counterpart.

7.4.4 For any given weight of SiC addition finer the SiC particles better is the Ultimate Tensile Strength. Similarly for any given SiC particle size the Ultimate Tensile Strength of twin rolled strips formed out of aluminium SiC MMC indicates that the Ultimate Tensile Strength is directly proportional to amount of SiC addition.
4.5 On the whole the mechanical properties of twin rolled aluminium SiC MMC is superior to its twin rolled strip matrix alloy counterpart. It is observed that the extent of improvement is of the order of 7%.

7.5 CONCLUSION SUMMARY

7.5.1 A twin roll casting machine was successfully fabricated and designed. The machine is capable of producing thin strips of aluminium 6061 and 2025 alloys directly from liquid metal with an acceptable quality level. (Fulfilling both the physical and mechanical property requirements).

7.5.2 For the first time in our country and perhaps in the world metal matrix composite (in present case aluminium SiC MMC) was successfully used for producing sound quality thin strips directly from liquid metal. These aluminium SiC MMCs met the physical as well as mechanical property requirements.

7.5.3 The process being unique and new, an Indian patent is filed for claiming the processes and its use for the production of twin rolled cast MMC.