CHAPTER 3
EXPERIMENTAL SET-UP

3.1 INTRODUCTION

This chapter focuses the experimental setup relevant to casting, unanimously used by the researchers called stir casting technique is adopted. The prepared composite is retreated by the polishing agents for the removal of unwanted material present on the outer layer of the composite. The Non-traditional machining technique Wire electrical discharge machining (WEDM) is coined for the machining. The responses of machining are later verified with the Surface roughness tester and Weight ratio factor which raise the results of Surface roughness value \(R_a\) in microns) and Material removal rate (MRR in \(\text{mm}^3/\text{sec}\)). In addition to that the interaction of particles mingled to form composite is scanned using Scanning Electron Microscope, the results depicts the interaction of the pattern of the material.

3.1.1 Stir Casting Process

Stir casting process is a special type of casting in which stirring action is carried out in the furnace itself. The Figure 3.1 shows the stir casting process. It consists of two muffle furnace, one is a big furnace with stirrer setup and another is a small one.

The stir mechanism consists of threaded rod carries a four bladed disc. It can be raised or lowered by handle depending upon the molten metal solid or liquid. A thermocouple is provided to measure the temperature and nitrogen gas purged for improving the metal yield. A measured quantity of magnesium is taken into the crucible. The cap is closed on the top of the
crucible and air is purged out using nitrogen. Gas burner is turned on to melt the magnesium. When it is melted, the stirrer is brought down and motor is actuated. Stirrer mixes the molten magnesium with uniform measured quantity of silicon carbide. The secondary step involves the preheating of the silicon carbide particles. The silicon carbide may contain impurities like water vapor, sulphur etc. The silicon carbide is heated to the matrix temperature to remove these impurities. When the metal melts, heat supplied from the burner is cutoff and it is allowed to cool, so that it attains a semi-solid state. In this state, the calculated amount (wt %) of silicon carbide is slowly added and stirred continuously for few minutes. The composite is then allowed to solidify inside the crucible only. After removing the composite from the crucible, it is cut into required shapes using shaping machine. The surfaces are then polished using grinding and polishing machine for micro structural analysis. The specimens are made into required shapes for testing.

**Figure 3.1 Stir casting Technique** (Recep Calin)
3.2 WIRE ELECTRIC DISCHARGE MACHINING SETUP

The experiments were carried out on a WEDM machine (SPRINT CUT 734 DI WATER WEDM) installed at ALFA WIRE cut EDM Private LTD., Ganapathy, Coimbatore. Tamilnadu, India. The three major parts of Machine tool are sprint cut 734 DI water WEDM with control panel, di-electric chamber and work piece as shown 3.2, 3.3 & 3.4.

![Figure 3.2 Sprint cut WEDM Machine (Electronica)](image1)

Figure 3.2 Sprint cut WEDM Machine (Electronica)

![Figure 3.3 Di-electric chamber](image2)

Figure 3.3 Di-electric chamber
The specifications of WEDM Experimental setup are given below:

**Table 3.1 Specifications of Sprint cut WEDM Machine**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table Travel (X &amp; Y axes)</td>
<td>300 mm x 260 mm</td>
</tr>
<tr>
<td>Z axes travel (Manual)</td>
<td>150 mm</td>
</tr>
<tr>
<td>Aux. Table travel (U &amp; V axes)</td>
<td>30 x 30 mm</td>
</tr>
<tr>
<td>Max. Size of work piece</td>
<td>450 x 300 x 150 mm</td>
</tr>
<tr>
<td>Max. Weight of work piece</td>
<td>100 Kgs.</td>
</tr>
<tr>
<td>Taper Angle</td>
<td>5/100 mm</td>
</tr>
<tr>
<td>Wire diameter</td>
<td>0.2 and 0.25 mm</td>
</tr>
<tr>
<td>Ball screws</td>
<td>Hardened and ground.</td>
</tr>
<tr>
<td>Guide ways</td>
<td>Linear motion guide ways</td>
</tr>
<tr>
<td>Main machine dimensions</td>
<td>1100x700x1500mm ht</td>
</tr>
</tbody>
</table>

### 3.3 WORK PIECE AND TOOL MATERIAL

The specimens are prepared as a square Blank of 10mm thickness and 100x100mm width made of Al/SiCₚ & Mg/SiCₚ composites separately, which are machined by WEDM as shown in Figures 3.2 & 3.3. The workpiece is shown in Figure 3.4. The experiment was conducted in ‘SPRINT CUT 734 DI WATER WEDM’ having an operating current of range 0-300 amps, power supply of 415V AC, 50 Hz and wire feed range of 0.2-2 mm/min. NINE holes of 5mm in diameter are drilled on the work piece. The tool material used was molybdenum wire.
3.4 MEASUREMENT OF EXPERIMENTAL PARAMETERS

The discussions related to the measurement of WEDM experimental parameters e.g. Material removal rate (MRR) and surface roughness (R_a) are presented in the following subsections.

3.4.1 Material Removal Rate (MRR)

Material removal rate (MRR) has been calculated from the difference of weight of work piece before and after experiment by using the following formula,

$$MRR = \frac{W_t - W_f}{\rho t}\text{mm}^3/\text{sec} \quad (3.1)$$
Where,

\[ W_i \] is the initial weight of work piece in grams

\[ W_f \] is the final weight of work piece in grams

\( t \) is the machining time in seconds

\[ \rho \] is the density of magnesium composites (gm/mm\(^3\))

\[ = (7.8 \times 10^{-3} \text{ gm/mm}^3) \]

### 3.5 SUMMARY

Hence the precise efforts have been made on selecting the experimental setup carried out in the research work. The chapter clearly illustrates the experimental setup and the necessary equipments for responses evaluation and the valediction of the final results. The next chapter discuss about the experimental design and the experimental readings with the knowledge of the previous chapter.