

**Mg-1**  
**TECHNICAL SPECIFICATION FOR CUSTOM DESIGNED BOTTOM POURING  
MICROWAVE PROCESSING UNIT**

**Required mandatory specifications**  
**(All the conditions should be met)**

**1. Technology requirement**

- 1.1. Microwave based fabrication process for development of Mg in-situ composites should have bottom pouring stir casting set-up with microwave and resistant based heating source. Microwave heat source should be capable of completely melt the metallic ingot with a sufficient holding time at a specific temperature.
- 1.2. The maximum operating temperature should reach 1600 °C or more and the holding time at a specific temperature should be minimum 10 hour.
- 1.3. The manufacturing unit should be capable of processing Mg alloy and its composites without any environmental hazardous, since Mg easily catch fire while processing in normal environment.
- 1.4. Equipment should have high vacuum provision to avoid chances of fire throughout the fabrication process.
- 1.5. The size of the crucible such that it can hold in the range of 200 gm to 2kg of metallic ingots and the molten material should not stick in the wall of crucible.
- 1.6. The mechanical stirring blade should be 2 stage type and the speed should be variable from 50 rpm to 400 rpm.
- 1.7. The microwave should not interact with stirring blade material.
- 1.8. The processing set-up should have provision to integrate ultrasonic vibrator additionally when necessary and microwave should not interact with probe material.
- 1.9. Microwave furnace should have proper cooling and insulation capacity.
- 1.10. Proper bottom pouring arrangement with vacuum should be provided and after each casting there should not be blockage of material in the passage.
- 1.11. Additional die heater should be provided in the set-up to preheat die with proper vacuum arrangement and the maximum temperature should reach 450 °C or more.
- 1.12. Control system should have high precision temperature sensor and variable temperature control mode.
- 1.13. The equipment must have provision to preheat the powder with a temperature range of 100 °C to 500 °C with proper temperature/environmental control.
- 1.14. The instrument should have capability to measure (i) furnace temperature, (ii) molten material temperature during processing, (iii) die temperature and (iv) powder preheater.

1.15. Operation of the instrument should be fully automatic and with user friendly software and data acquisition system.

1.16. The manufacture should give proper demo of fabrication of Mg in-situ composite before installation in IIT Madras.

## **2. Furnace requirement**

2.1. The furnace should operate in controlled atmosphere.

2.2. Microwave applicator cavity size should be minimum 400 mm (or higher) x 400 mm (or higher) x 400 mm (or higher). and for hot working zone 150 mm (or higher) x 150 mm (or higher) x 150 mm (or higher).

2.3. Outer shell, door and applicator cavity should be with SS 310L with proper heat resistance paint coating.

2.4. Proper water-cooling circulation should be done, so that the skin temperature will reach near to ambient temp.

2.5. Proper ceramic fiber board insulation should be in all side.

2.6. The minimum size of susceptor should be 40 mm (or higher) x 40 mm (or higher) x 10 mm (or higher). The supplier should provide at least 50 numbers of susceptors.

## **3. Microwave based heating system**

3.1. The furnace should operate with multiple magnetrons (2.45GHz) with input power source in three phase/AC.

3.2. Each magnetron power should be minimum 1kw anode voltage of 2.2 kV and anode current of 1.5 A and total of minimum 8 kw.

3.3. The power mode should be variable.

3.4. The maximum temperature should reach is 1600 °C or more with a rate of heating 5 to 20 °C or more.

3.5. Microwave should have proper wave guide and isolator.

3.6. The transformer should have minimum power of 3Kw.

3.7. Proper earthing and cooling should be provided.

## **4. Resistant based heating system**

4.1. The maximum temperature should be minimum 1500 °C.

4.2. The required power should be 6 Kw or more.

4.3. Proper air cooling and insulation should be provided.

4.4. The heating element material should have high temperature resistance (at least it sustains 1600 °C).

4.5. There should be proper calibration and temperature control.

## **5. Cooling system**

5.1. A chiller unit should provide for cooling.

5.2. The capacity should be minimum 200 liter.

5.3. Cooling temperature should be below 25 °C.

5.4. There should be proper temperature control.

## **6. Bottom pouring casting with mechanical stirrer**

6.1. The crucible capacity should be minimum 2 kg with one additional crucible.

6.2. The opening and closing should be fully automatic with proper control.

6.3. The mechanical stirring blade should be 2 stage type and the speed should be variable from 50 rpm to 400 rpm.

6.4. The maximum die preheater temperature required is 450 °C with proper control.

6.5. Proper insulation should provide.

6.6. During pouring, vacuum should work properly.

6.7. Manufacture should provide rectangular molds with following geometries in inner mould dimentions: 10 mm (thickness) X 100mm(width) X 300 mm (length) - 3 numbers

6.8. There should be suitable provision to easily integrate horizontal extrusion press at the outlet of bottom pouring passage.

## **7. Vacuum Unit**

7.1 The vacuum chamber should be capable to long holding of minimum desired Vacuum of  $10^{-2}$  mbar and as high as  $10^{-4}$  mbar is preferable.

7.2 Safety devices/Interlocks: The unit should have safety devices/interlocks for the safety of the machine/operator.

## **8. Automation and Control system**

8.1. Data Acquisition system and software should be user friendly.

8.2. The manufacturer should provide minimum i7 Processor, 8GB Ram, 1TB Hard disk, 2GB Graphics card, Anti-virus, windows 10 OS, UPS system.

8.3. Control system should have high precision temperature sensor and variable temperature control mode.

## **9. Ultrasonic vibrator**

- 9.1. The frequency should be 20 KHz and if possible, can provide variable frequency mode.
- 9.2. Power required is 1 to 3 KW (We need variable power mode in this range with 0.5 KW interval)  
\* if possible, supplier can provide up to 5 KW.
- 9.3. Probe material should be material Ti-6Al-4V (if possible high temperature resistance material with or without coated because our operating temperature is 1000-1500 °C).

## **10. Other conditions**

- 10.1. Warranty for 3 years from the date of installation/commissioning.
- 10.2. AMC for 2 years after the warranty period
- 10.3. The supplier should provide all the consumables for at least 5 years. The price for individual consumables for 5 years should be quoted separately.
- 10.4. The spares and accessories requirement after warranty period for at least 2 years have to be quoted separately.
- 10.5. Installation should be done by factory trained engineers at our institute, free of charge.
- 10.6. Operation, service and maintenance training should be provided to at least five persons for a minimum of two days.
- 10.7. One set of maintenance and operating manuals in English (with a hard copy)
- 10.8. The offer should be made @ 5 % GST against a concessional GST certificate.
- 10.9. Equipment to be delivered in test ready, factory calibrated condition.
- 10.10. Supplier must have supplied any kind of Microwave based units to at least 2 NITs or 2 IITs or 2 government R& D laboratories in India.
- 10.11. The firm should be equipped with well-trained engineers to offer post warranty maintenance and service support.
- 10.12. The nearest service centre is to be mentioned.
- 10.13. Compliance statement needs to be provided clearly specifying COMPLY/NON-COMPLY with remarks/reasons of all of the points mentioned above