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# Design and Fabrication of Gas Furnace For Stir Casting

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**ABSTRACT**
Need of new materials is always important in industries, better mechanical properties and lower in cost are the main parameters which attracts everyone to develop a new material. This need arises in the form of composite materials. This paper reviews about the composites, their existence, fabrication by stir casting and the characterization of metal matrix composites. Different fabrication techniques were mentioned which can be used for the manufacturing of metal matrix composites but specially focused on stir casting. Uses of stir caste in the various researches are shown in this paper and which gives us better idea to understand various parameters for stir caste like stirrer speed, melting temperature, spindle speed and percentage of reinforcement. Characterization of a metal is always important to describe its properties and which is described with different testing. It explains the revised property of metal matrix composites and that shows it is far better than the parent metal.

**Key word:** Gas furnace design, stir casting, fabrication, insulation, temperature control, crucible, heating element, safety, efficiency, testing.

## I. INTRODUTION

The introduction of a design and fabrication report for a gas furnace for stir casting should outline the purpose and significance of the furnace in the stir casting process. It should provide background information on stir casting, highlighting its importance in metal processing and fabrication. Additionally, it should introduce the need for a specialized gas furnace tailored to the requirements of stir casting, emphasizing its role in achieving precise temperature control and uniform heating necessary for the process. This section sets the stage for the rest of the report by establishing the context and motivation behind the development of the gas furnace.

## II.LITERATURE REVIEW

Design and fabrication of a gas furnace for stir casting, you'd want to explore existing research and studies related to gas furnaces, stir casting processes, and their integration. Look for papers, articles, and patents that discuss Gas furnace design parameters such as heating capacity, insulation materials, burner types, and temperature control mechanisms.Previous works on stir casting techniques, including the equipment used, process parameters, and outcomes in terms of material properties.Integration of gas furnaces with stir casting setups, focusing on challenges, optimizations, and performance improvements. Comparative studies evaluating different furnace designs or heating methods for stir casting applications. Any innovations or novel approaches proposed in the literature for enhancing the efficiency, reliability, or versatility of gas furnaces in the context of stir casting.By synthesizing and analyzingthis existing literature, you can identify gaps in knowledge, potential areas for improvement, and opportunities for further research in designing and fabricating gas furnaces specifically tailored for stir casting application

## III .PROBLEM SOLVING:

**A Requirement Analysis**: Understand the specific requirements of the stir casting process, including the type and amount of metal being melted, desired temperature range, and casting volume.

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**Designing the Furnace**: Based on the requirements, design the furnace layout, size, and shape. Consider factors like insulation, burner type, refractory materials, and safety features.

**Selecting Materials**: Choose materials for the furnace body, insulation, burner, and crucible based on their heat resistance, durability, and compatibility with the molten metal.

**Building the Furnace**: Fabricate the furnace according to the design specifications. This involves assembling the furnace body, installing insulation, placing the burner system, and adding safety mechanisms such as temperature controls and gas shut-off valves.

**Testing and Calibration**: Test the furnace to ensure it reaches and maintains the desired temperature range consistently. Calibrate temperature controls and safety features to operate effectively.

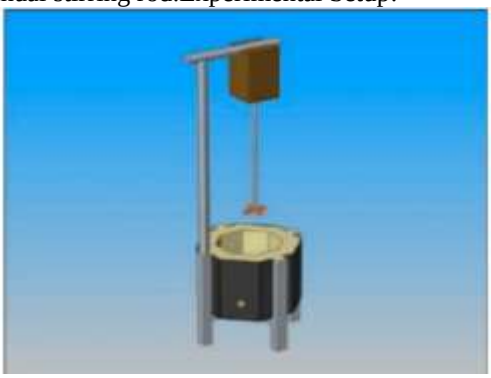
**Optimization and Fine-tuning:** Adjust the furnace settings and configurations as needed to optimize performance, energy efficiency, and casting quality.

**Safety Precautions**: Implement safety protocols for operating the furnace, including proper ventilation, gas leak detection, and emergency shut-off procedures.

**Documentation and Maintenance**: Keep detailed records of the furnace design, fabrication process, and operating procedures. Establish a regular maintenance schedule to ensure the furnace remains in good working condition.By following these steps and paying attention to detail, you can successfully design and fabricate a gas furnace for stir casting, ensuring efficient and reliable production of high-quality castings.

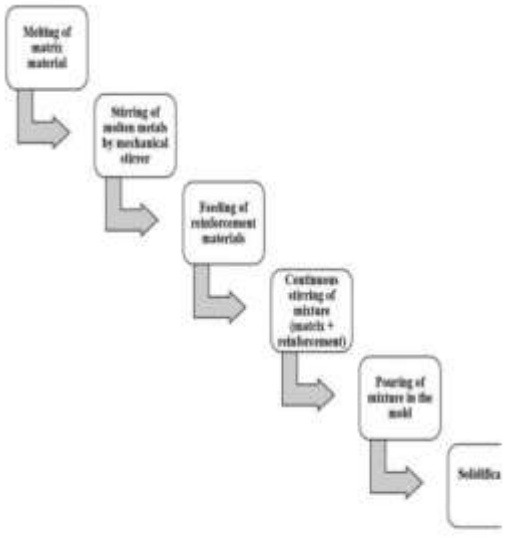
## IV .EXPERIMENTAL SETUP:

Determine the size and capacity of the furnace based on the volume of metal you'll be melting.choose materials that can withstand high temperatures and corrosive environments, such as refractory bricks or ceramic fiber insulation. design a crucible that can hold the metal and withstand the heat.Include safety features such as gas flow control, temperature monitoring, and ventilation.Fabrication Process:Construct the furnace shell using metal sheets or refractory material.Install the insulation material inside the furnace shell to minimize heat loss.Fabricate the burner assembly with appropriate nozzles for efficient combustion.Install a temperature sensor and control system to regulate the furnace temperature.Fabricate the crucible using heat-resistant materials such as graphite or ceramic.design and install a mechanism for stirring the molten metal, such as a motorized stirrer or manual stirring rod.Experimental Setup.



3D MODEL STIR CASTING SETUP

Place the furnace in a well-ventilated area with proper safety measures in place. gas flow regulation.Load the crucible with the metal to be melted and place it inside the furnace.Start the gas burner and gradually increase the temperature to melt the metal.Once the metal is molten, initiate the stir casting process by activating the stirring mechanism.Monitor the temperature and stirring process throughout the experiment.After casting, allow the metal to solidify before removing it from the crucible.Safety Precautions:Wear appropriate personal protective equipment, including heat-resistant gloves and eye protection.Ensure proper ventilation to prevent the buildup of hazardous gases.Keep a fire extinguisher nearby in case of emergencies.Follow all safety guidelines and regulations for operating gas furnaces and handling molten metals.




Flow chart diagram of Stir Casting process.

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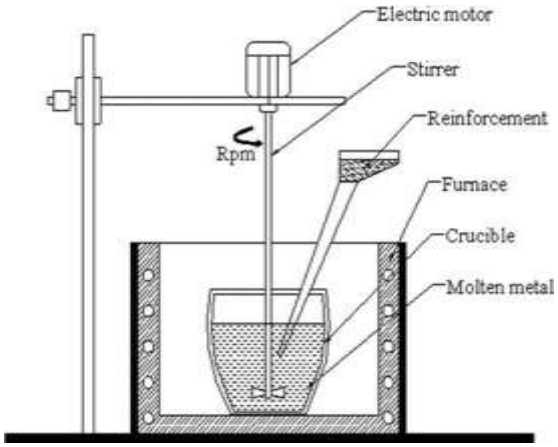
## V. FARICATION

A gas furnace is typically used to heat the metal or alloy to its liquid state. The furnace provides a controlled environment for melting, ensuring consistent temperature and preventing impurities from contaminating the molten material. Once melted, the metal is poured into a mold while being stirred, usually with a rotating impeller or rod, to disperse any added particles or reinforcements evenly throughout the material. This method is commonly employed in the fabrication of metal matrix composites, where particles like ceramics or carbon fibers are dispersed in a metallic matrix to enhance mechanical properties such as strength, stiffness, or wear resistance. The use of a gas furnace allows for precise control over the melting process, resulting in high-quality castings with desirable properties.

## VI. ASSEMBLY OF COMPONENTS

In the process of stir casting, also known as liquid metal stirring or liquid metal processing, a gas furnace is typically used to heat the metal components to their melting point. This furnace can be fueled by natural gas, propane, or other combustible gases. The metal components are placed in a crucible inside the furnace, where they are gradually heated until they liquefy.Once the metal components reach a molten state, a stirring mechanism is employed to mix them thoroughly. This stirring can be achieved through various methods, such as using rotating blades, electromagnetic fields, or ultrasonic vibrations. The stirring helps to ensure uniform distribution of any alloying elements or reinforcement materials, resulting in a homogenous mixture.

After the stirring process is complete, the molten metal can be poured into molds to create the desired shape or form. Once cooled and solidified, the components will retain the properties imparted by the stirring process, such as improved mechanical strength, enhanced ductility, or better resistance to wear and corrosion.Stir casting is widely used in the production of metal matrix composites (MMCs), where a metallic matrix is reinforced with ceramic particles, fibers, or other materials to enhance its properties. It is also employed in the manufacturing of alloys with tailored compositions and microstructures for specific applications in industries such as automotive, aerospace, and electronics.




LAYOUT OF DIAGRAM OF STIR CASTING

## VII. SPECIFICATION

| COMPONENTS | SPECIFICATION |
|---|---|
| AC Motor | 1 Nos – 600 rpm (0.25 BHP) |
| Plummer Block Bearing | 25 mm diameter |
| Pulley – A groove type | Connected with motor = two groove pulley, 50 mm diameter each connected with stirring rod: bigger groove pulley = 150 mm diameter. Smaller groove pulley = 125 diameter |
| Stirring Rod | Material – Stainless steel Length = 900 mm Diameter= 25 mm |
| Stirring Blade | Material – stainless steel Length – 25 mm Thickness – 8 mm |
| Belt Type | V Belt – B 45 Groove type Length – 1143 mm Width – 17 mm Thickness - 6 mm |

## VIII. CONCLUSION

Gas furnaces are commonly used in stir casting processes due to their ability to provide precise temperature control, which is crucial for achieving the desired properties in the final casting. These furnaces typically utilize natural gas or propane as fuel, allowing for consistent and uniform heating of the melt.One of the key advantages of gas furnaces is their versatility. They can handle a wide range of metals and alloys, including aluminum, copper, brass, and various other non-ferrous materials commonly used in stir casting applications. This versatility makes gas furnaces suitable for a variety of industries, from

automotive to aerospace, where stir casting is utilized for producing high-quality components.Gas furnaces also offer energy efficiency benefits compared to other heating methods, such as electric resistance furnaces. They can reach operating temperatures quickly and maintain them with minimal energy consumption, reducing production costs in the long run

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