

Performance Improvement of Stir Casting Blade

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ABSTRACT: Generally, stir casting process plays major role in case of Metal Matrix Composites (MMC) for attaining better mechanical properties. In this process the stir blade with shaft coupled with electric motor is used to stir the reinforcement with the molten metals. During this process, a major problem identified is agglomeration, improper mixing of reinforcement, sedimentation on the blades and crucible surface. Uniform distribution mainly depends upon the speed at which blade rotates.

Apart from that reinforcement particular high thermal conductivity. During stir sedimentation of blade corners leads to melt the blade due to high heat transfer rate. To solve these problem the blade edges are made fillet of 2mm.

I. STIR CASTING

In a stir casting process, the reinforcing phases are distributed into molten matrix by mechanical stirring. Stir casting of metal matrix composites was initiated in 1968, when S. Ray introduced alumina particles into an aluminum melt by stirring molten aluminum alloys containing the ceramic powders. Mechanical stirring in the furnace is a key element of this process. The resultant molten alloy, with ceramic particles, can then be used for die casting, permanent mold casting, or sand casting. Stir casting is suitable for manufacturing composites with up to 30% volume fractions of reinforcement.

The cast composites are sometimes further extruded to reduce porosity, refine the microstructure, and homogenize the distribution of the reinforcement. A major concern associated with the stir casting process is the segregation of reinforcing particles which is caused by the surfacing or settling of the reinforcement particles during the melting and casting processes. The final distribution of the particles in the solid depends on material properties and process parameters such as the wetting condition of the particles with the melt, strength of mixing, relative density, and rate of solidification. The distribution of the particles in the molten matrix depends on the geometry of the mechanical stirrer, stirring parameters, placement of the mechanical stirrer in the melt, melting temperature, and the characteristics of the particles added.

An interesting recent development in stir casting is a two-step mixing process. In this process, the matrix material is heated to above its liquidus temperature so that the metal is totally melted. The melt is then cooled down to a temperature between the liquidus and solidus points and kept in a semi-solid state. At this stage, the preheated particles are added and mixed. The slurry is again heated to a fully liquid state and mixed thoroughly. This two-step mixing process has been used in the fabrication of aluminum.

Among all the well-established metal matrix composite fabrication methods, stir casting is the most economical. For that reason, stir casting is currently the most popular commercial method of producing aluminum based composites.

II. PROBLEM IDENTIFICATION

Generally, stir casting process plays major role in case of Metal Matrix Composites (MMC) for attaining better mechanical properties. In this process the stir blade with rod coupled with motor is used to mix the reinforcement

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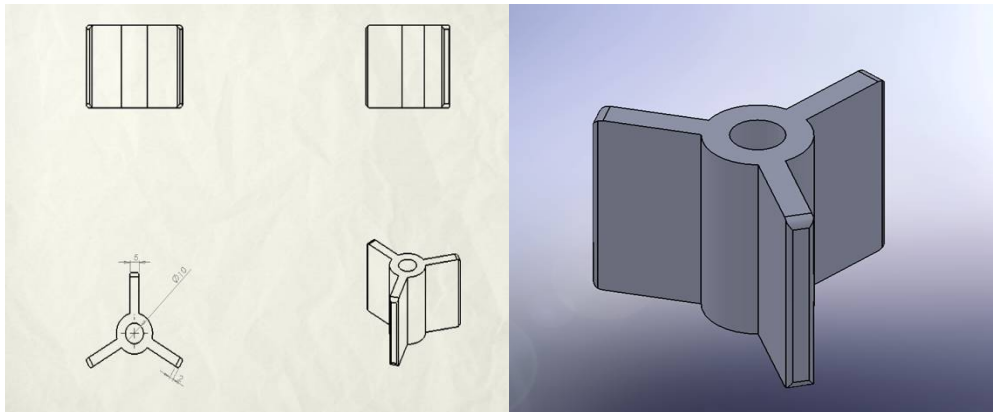
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with the molten metals. During this process, a major problem identified is ash formation, improper mixing of reinforcement, sedimentation of molten metal in the preheater and diffusion of corners of blade. This may be mainly due to the speed at which blade rotates, the tilt angle of the stir blade, the number of blades provided and the time period of inserting the stirrer blade into the preheater.

III. PROBLEM SOLUTION

Considering these issues, we have planned to increase the number of blades. 3 in number for proper mixing of reinforcement with the molten metal and as well altering the blade edge by making fillet in it.

PROPOSED DESIGN OF STIRRER WITH 3 BLADES



HEAT TREATMENT AND HARDNESS TEST

Before heat treating the stir blade hardness value of the blade is checked by using brinell hardness machine. Then the blade which is made up of mild steel is heated up to its recrystallization temperature and it is quenched in lubrication oil SAE J300 Finally the hardness value of mild steel is checked using brinell hardness machine.

IV. RESULT AND DISCUSSION

The obtained hardness values of normal mild steel and heat treated mild steel are compared. By comparing the values we came to know that heat treated stir blade possess better hardness than normal mild steel.

By providing fillet in the corner of the stir blade damages like corner corrosion are eliminated so the blade perform better than the normal stir blades. This stir blade have 3 blades which give proper stirring effect than 2 blade setup.

The table below shows the properties of mild steel blade is improved by heat treatment process. Thus the blade perform longer life than the normal blade.

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Mild steel hardness value				
	Brinell		Rockwell	
Specimen	Impression diameter(mm)	Hardness	Hardness B	Hardness C
Mild steel before heat treatment	4	227	98	21
Mild steel after heat treatment	4	242	112	26

V. CONCLUSION

Thus, the stirrer with 3 blades provides better turbulence inside the furnace. The major problem identified as ash formation is reduced by creating better turbulence. The other problems which are improper mixing of reinforcement, sedimentation of molten metal in the preheater are reduced. By providing fillet, edge corrosion of the blade is reduced and life time of the stir blade is increased.