Effect of extrusion on tensile behavior of S Glass and Fly ash reinforced Al 7005 hybrid composites.

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Abstract: Metal Matrix Composites (MMCs) are most capable in accomplishing improved mechanical properties and wear properties due to the presence of reinforced particles. Aluminium is used in various applications because of its light weight and corrosion resistant. In the present work, Al7005 matrix alloy is reinforced with different Weight % of S-Glass and Fly-ash were prepared through stir casting technique and hot extruded at a ratio of 5.32:1. The extruded Al 7005 hybrid MMCs were later subjected to tensile test and compared with casted composites. The properties of extruded hybrid MMCs were found to be better than the hybrid MMCs. It is observed that Yield strength (YS) of extruded Al 7005 +5% S-Glass+6% Fly ash hybrid MMCs improved by 7.43% and Ultimate tensile strength (UTS) of extruded Al 7005 +5% S-Glass+6% Fly-ash hybrid MMCs improved by 7.43%, While percentage of elongation is reduced to 14% than casted composites.

Keywords: Al7005 alloy; S-Glass; Fly-ash; hybrid MMCs, Hot Extrusion

1. INTRODUCTION
Composite materials in general are the materials which are engineered combinations of two or more materials tailored to get the desired properties. The matrix phase and reinforcement phase with significantly different physical or chemical properties, which are constituents of any composite material exhibiting properties which are different from the individual components. Metal matrix composites (MMCs) are made of metallic matrix with one or more discontinuous reinforcing phases [1]. Many researchers have carried out research using varieties of reinforcement’s ceramics such as carbides, oxides and nitrides [2-6]. These reinforcements are quite expensive. Most of the researchers conduct tests on primary processed methods i.e. liquid metallurgy such as stir casting [7-8]. Very less work has been done on the secondary process such as rolling, extrusion, wire drawing etc. [9]. Several researchers have worked such reinforcements. C.S. Ramesh et al.[10] studied the effect of extrusion ratio on wear behaviour of hot extruded Al6061–SiCp (Ni–P Coated) composites. Vipin K. Sharma et. al [11]. Similarly, several researchers have worked on developing the noble composites with high strength and low cost [12-15]. The present work compares the effect of reinforcement on tensile behaviour of Al 7005 matrix alloy reinforced with S-glass and Fly ash hybrid composites and comparing the results as cast and extruded composites.

2. EXPERIMENTAL DETAILS
In the present study S-glass and fly-ash (5-10µm and 25-30µm respectively) were used as reinforcements with Al 7005 as matrix material. The different compositions of Al 7005 hybrid MMCs
were developed and later it was subjected to extrusion process extruded at a ratio of 5.32:1 maintaining a ram speed of 0.5 mm/sec with a billet temperature of 500°C as per literature [11].

2.1 Tensile Test Details
The tensile test was conducted as per ASTM E8M-15a standards. The extruded samples were cut and machined and the test was conducted in as per ASTM standards. Three specimens of each composition are tested and the average of three values are recorded.

3. RESULTS AND DISCUSSIONS

3.1 Comparison of Yield strength of as cast and extruded Al 7005 MMCs
Figure 1 shows the variation of yield strength (YS) of as cast and extruded Al 7005 hybrid MMCs.

![Figure 1: Variation of Yield strength values of as cast and extruded Al 7005 MMCs](image)

It is observed from the graphs that as the Wt % of S-Glass & Fly ash increases the yield strength of all the hybrid composites increases in both the cases. It can be found that Al7005 alloy and its hybrid MMCs has a better yield strength when compared with as cast Al 7005 and its hybrid MMCs after extrusion. The composite having 5% S-Glass with 6% Fly ash gives highest yield strength i.e. 231.51 MPa and this may be due to the good bonding of reinforcements with the matrix material. Similar trends have been observed by several researchers [16-18]. The enhanced strength of the extruded MMCs is due to the synergetic effects of both the reinforcements (S-Glass and Fly-ash).

3.2 Comparison of Ultimate Tensile strengths cast and extruded composites

![Figure 2 : Variation of Ultimate tensile strengthof as cast and extruded composites](image)
Figure 2 shows the variation of Ultimate tensile strength (UTS) of different Al 7005 hybrid MMCs before and after extrusion. It is observed from the graphs that, as the Wt% of S-Glass & Fly ash increases the ultimate tensile strength of all the hybrid composites has been increased in both as cast and extruded composites). From the results is observed that the extruded composite having 5% S-Glass with 6% Fly ash gives highest tensile strength of 263.08 MPa, This increase may be due to the dispersion of hard phases of reinforcements in soft ductile matrix and due to the excellent adhesion of S-glass and Fly ash particles to Al 7005 matrix, which resists estrangement during tensile loading [19-20]. This may be ascribed to heavy residual stress induced thru solidification and generation of density dislocation. The enhanced strength of the extruded MMCs is due to the synergetic effects of both the reinforcements (S-Glass and Fly-ash).

3.3 Comparison of Ductility of as cast and extruded composites.

From figure 3, it is observed that, as the Wt% of S-Glass & Fly ash increases the ductility of composites decreases in both the cases. It is noticed that, there is a slight improvement in ductility of hybrid MMCs. The composite having 5% S-Glass with 6% Fly ash gives least ductility and this may be attributed to fact that with enhanced reinforcement i.e. S-glass and Flyash leads to inherently brittle phases and presence of intermetallic phases aids as possible locations for crack nucleation resulting to reduction in ductility under quasi-static loading [19-20].

4. CONCLUSIONS

A thorough study on tensile properties have been done on the Al 7005 alloy reinforced with S-Glass with 6% Fly ash. Comparison studies have been done on as cast and extruded hybrid MMCs. It can be concluded that the tensile properties i.e. Yield strength (YS) and Ultimate tensile strength (UTS) of extruded Al 7005 hybrid MMCs shows better improvement compared to as-cast composites. It is noticed that the Al 7005 reinforced with 5% S-Glass and 6% Fly-ash shows highest yield strength of 231.51MPa against 215.49MPa and Ultimate tensile strength of 263.08 MPa against 244.88 MPa for extruded and as-cast composites respectively. While the ductility of hybrid composites reduces to 10% from 16.02%.

5. REFERENCES

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