iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VIII **Month of publication:** August 2020

DOI: https://doi.org/10.22214/ijraset.2020.30811

Analysis of the Experimental and Final Elements of the Compression Behavior of B4C / FA / GR Particles / 5083 Hybrid Matrix

Porana Kalyan Kumar[1], Raja Ratna Kumar V[2], Dr. U. S. Ramakanth[3]
[1, 2]M. Tech Student, Department of Mechanical Engineering, #VITAM, Vizag, AP
[3]Associate Professor, Department of Mechanical Engineering, *LENDI Engineering College, Vizag, AP

Abstract: Aluminium 5083 alloy reinforced with B4c/FA/Gr metal matrix composite was fabricated at different weight ratios 6,9 and 12 mmcs using stircasting method under vertex route. The objective of this work is to determine the non linear plastic properties of AA5083 and their composites using a powerful finite element analysis software ANSYS. The ANSYS results are compared with analtical calculations and they are very close to each other. Two different aspect ratios (H/D 1.0 and H/D1.5) are consider for the these composites to analysie the axial,hoop and hydro satatic stress for all the cases of metal matrix composites. AA5083+9MMC composite very close to the effective strain line compare to other composites and base alloy it indicates the good ductile properties are presented. H/D ratio 1.5 the hoop stress is increased for 9 and 12 MMC compare to 6MMC and base alloy it indicates that they are exhibit the good plastic properties.

Keywords: Upset forging, Plastic analysis, AA5083, ANSYS, aspect ratios

I. INTRODUCTION TO PHASE CHANGE MATERIALS AND METHODOLOGY

The finite element analysis of the deformation behavior of the cold change process was performed with ratios of 1.0 and 1.5 dimensions for cylindrical samples. Since high-speed computing computers are now available on the market, computing time is not a major constraint to solving problems with 3D models. The finite-element analysis of the deformation behavior of the cold change process of all baB4c metal and alloy compounds (A2024) was carried out with transverse ratios of 1.0 and 1.5 in the dry state. Work has been done to study the result of dispersion of alloy components in the base metal using the compound manufacturing method. Al-Cu compounds (5-15% by weight) are prepared by a vortex method by dispersing copper powder in a molten alloy A2024. The results are compared with an alloy that has the same concert. Also compounds containing 5, 10 and 15% by weight were compared.Deformation and flow studies were performed and results were compared with methods of finite elements in terms of hydrostatic pressure and compression. [1-3].

A three-dimensional piston model is designed and modeled for Solid Works 3D modeling software. Finite element analysis on the piston is performed using aluminum 6061 and aluminum 5083 to determine pressures and frequencies. The analysis is done in Ansys. Copper cold workability limits have been studied as a function of friction, aspect ratio and sample geometry. The nature of the hydrostatic stress was found on the edge of the sample with an edge to form a tensile strength. The ANSYS finite element program was applied to analyze the turbulent modulation process.

Cylindrical samples of Al Mg alloys were treated with a content of Mg 2 to 8% by weight in solution at 450 ° C for two hours and lifetime at 200 ° C. The effect of focusing and deformation was studied. Magnesium on the aging behavior of Mg alloys. [4-6]. Cold decomposition experiments were carried out in the form of a homogeneous fly ash ash / AA2024 / pallet. The study aimed to assess deformation behavior.

Detailed comparisons of experimental variables were made with the results of the finite element method (FEM) to determine the accuracy with which the distortion process can be modeled [7]. A typical cold forging process is expected by linking rigidity and the effective development of deformation in a simple experimental process. Five different deformation ratios (13%, 17%, 32.4%, 41%, 50%) are considered for experimentation.

The sample thumbnail is processed using "Adobe Photoshop CS2" and "Image J" is applied to estimate the average grain size. The annoying process was simulated with the finite element action code, ANSYS ver11.0. The amount of particles present hardens the matrix by increasing the content of fly ash and B4c particles. Therefore, the observation was more resistant to corrosion. The MMC welding machine wears a lot with a smaller fraction of weight of fly ash and B4c particles, and the corrosion increases linearly over time. [8-10].

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VIII Aug 2020- Available at www.ijraset.com

II. FABRITION PROCEDURE AND EXPERIMENTAL WORK

The samples are fabricared using stir cating method, in this method cast iron die, inert gas, electric stirirer and graphite crusuble were used. The melting temperature of AA5083 is aproximately $900^{O}C$ at that condition the B4c,fly ash and graphite powders are poured into the graphite crusuble using electric strirer rotate the solidification minimum of 5miniutes at constant speed. The moilten metal was poured into the cast iron die then the required samples were fabricated as shown in figure1.1. The fabricated samples are machined as per the stndard dimensions of the compressed preforms with the help of CNC machine.

The Compression preforms aspect ratio (height to diametre) are consider 1.0 and 1.5 as shown in Fig 1.2 for the tri-stresses analysis. The compresion test was carried on universal testing machine as shown in Fig1.3. The test was carried out up to the shear failure of the sample free surface or 50% of deformation of the sample. The UTM genarate the load – displacement data for the AA5083 and their composites of H/D ratio 1.0 and 1.5.

Fig 1.1 stir casting set up and Fabricated Cylindrical samples

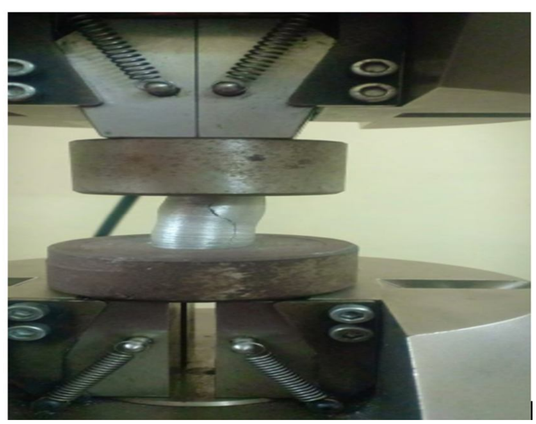


Fig 1.2 and 1.3 Machined Samples and compression test on UTM

III. ANALYTICAL CALCULATIOONS

The tri-stress are found for the plastic analysis of base and composites of MMCs using the follwing formulas are given in below.

True strain in axial direction $\epsilon_Z = \ln\left(\frac{Hi}{H0}\right)$

The true stress and true strain data were well fitted into the Hollow Man power law of equation for determination of deformed properties of the material as given in below.

$$\sigma f = K \in^{n}$$

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VIII Aug 2020- Available at www.ijraset.com

Where K is strength coefficient and n are strain hardening exponent.

The Hydro static Stress $\sigma_H = \frac{\sigma_z+\sigma_\theta+\sigma_r}{3}$

Where $\sigma_z, \sigma_\theta, and\ \sigma_r$ are axial, hoop and radial stress respectively in the orthogonal axis on compression test.

Axial Stress $\sigma_z = \sigma f[\{1-(\frac{1+2\propto}{2+\propto}) + (\frac{1+2\propto}{2+\propto})\}^2]^{-1/2}$, here $\propto$ is the slope between axial strain and circumferential strain and σf is the flow stress of the material.

The hoop stress $\sigma_\theta = \sigma_z\ [(\frac{1+2\propto}{2+\propto})]$ and the radial stress are zero on the free surface of the material. The table 1 and II show the strength and strain hardening exponents of different materials of H/D ratios 1.0 & 1.5.

TABLE I
STRENGTH COEFFICIENT (K)-H/D = 1.0 AND 1.5

S. No	Strength Coefficient (K)-H/D = 1.0	Strength Coefficient (K)-H/D=1.5
AA5083	935.08	625.14
AA5083+6% Composite	1109.53	3452.31
AA5083+9% Composite	1362.66	1214.02
AA5083+12% Composite	1362.66	2479.47

TABLE III
STRAIN HARDENING EXPONENT **(N)**-H/D = 1.0 AND 1.5

S. No	Strain Hardening Exponent (n)-H/D 1.0	Strain Hardening Exponent (n)-H/D=1.5
AA5083	0.641	0.521
AA5083+6% Composite	0.7799	1.2944
AA5083+9% Composite	0.8582	0.7708
AA5083+12% Composite	0.8582	0.892

IV. NUMERICAL ANALYSIS

Upsetting is most widely used metal forming phenomena for manufacturing of different machine components. As per aspect ratios the saples are desined in ANSYS APDL, the analysis was performed with the help of solid 182 element and contanct elements 182 and 183.The contant pair was creted and shown in Fig 1.4.The material properties of top and bottom dies of the UTM machine was assumed to be steel(E=210Gpa,µ=0.3) and the prepared samples are AA5083and their composites.

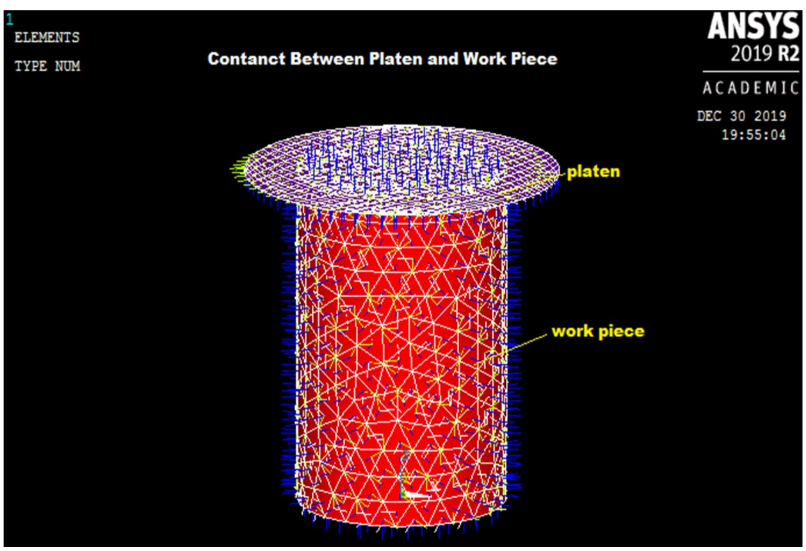


Fig 1.4 Contact elements pair of AA5083+6MMC for H/D ratio 1.5

The results show in tabular form in TableIII to VI reports the tri -stress for base alloy and composites of H/D ratio 1.0 and 1.5, the experment results are shown in the brackets.

TABLE IIIII
STRESS OF AA5083 OF H/D RATIO 1.0 AND 1.5

AA 5083	Maximum Displacement	Axial Stress	Hoop Stress	Hydrostatic stress
H/D1.0	10	-273.71(-280.15)	2.82(3.01)	-98.69(-105.36)
H/D1.5	15	-248.15(-255.14)	2.21(2.95)	-21.16(-23.58)

TABLE IVV
STRESS OF AA5083+6MMC OF H/D RATIO 1.0 AND 1.5

AA 5083 +6MMC	Maximum Displacement	Axial Stress	Hoop Stress	Hydrostatic stress
H/D1.0	10	-291.49(-312.59)	2.01(2.82)	-95.63(-105.11)
H/D1.5	15	-170.15(-174.93)	0.74(0.79)	-59.67(-57.93)

TABLE V
STRESS OF AA5083+9MMC OF H/D RATIO 1.0 AND 1.5

AA 5083 +9MMC	Maximum Displacement	Axial Stress	Hoop Stress /flow strain	Hydrostatic stress
H/D1.0	10	-270.69(-349.03)	3.10(3.26)	-77.50(-115.254)
H/D1.5	15	-240.16(-248.22)	13.22(14.26)	-80.05(-82.25)

TABLE VI
stress of AA5083+12MMC of H/D ratio 1.0 and 1.5

AA 5083 +12MMC	Maximum Displacement	Axial Stress	Hoop Stress	Hydrostatic stress
H/D1.0	10	-309.47(-315.11)	2.95(3.41)	-93.16(-100.21)
H/D1.5	15	-327.25(-332.52)	20.22(22.56)	-103.36(-112.54)

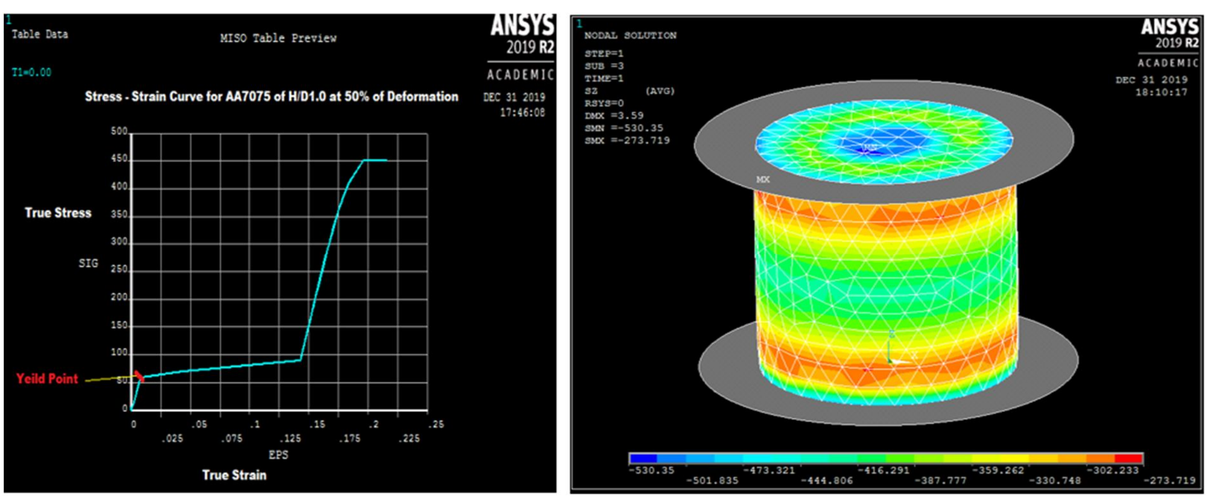


Fig 1.5 The true stress-strain curve and Axial stress of AA5083 for H/D ratio 1.0

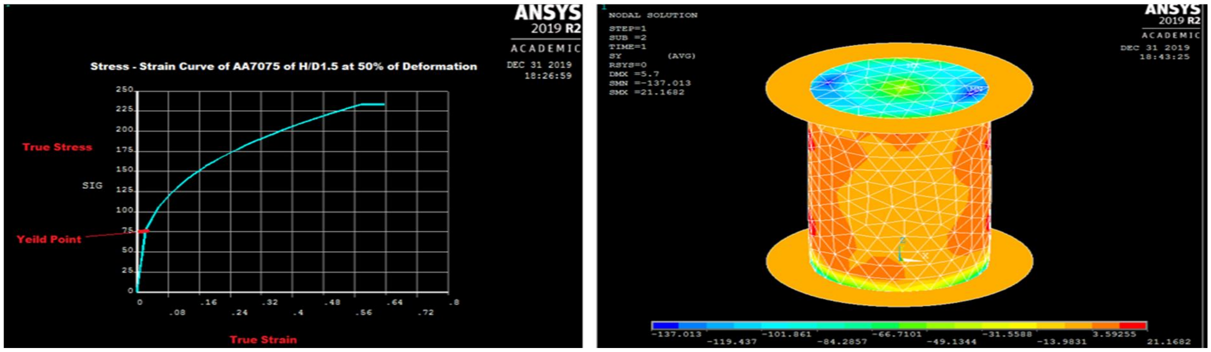


Fig1.6 The true stress-strain curve and Hydrostatic stress of AA5083 for H/D ratio 1.5

Fig1.7 True Stress- Strain curve and Axial Stress of AA5083+6MMC for H/D ratio 1.0

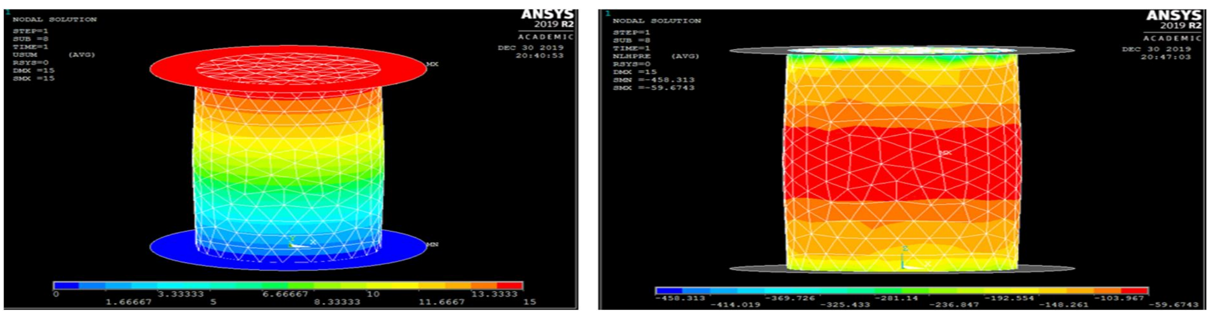


Fig 1.8Maximum Displacement and Hydro Static Stress of AA5083+6MMC for H/D ratio 1.5

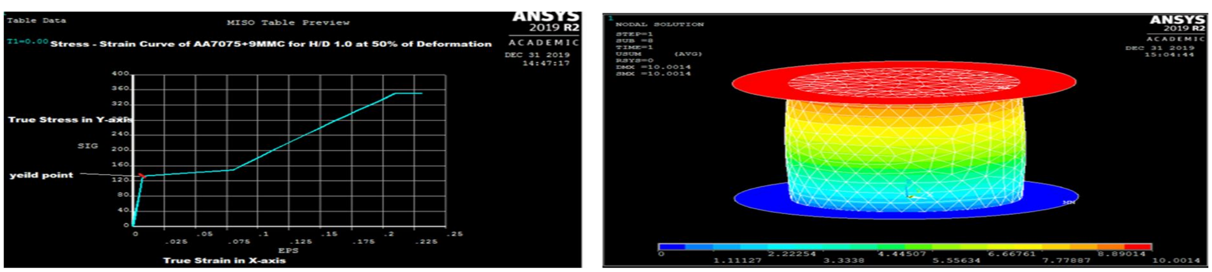


Fig 1.9True stress-strain and Maximum Displacement of AA5083+9MMC for H/D ratio 1.0

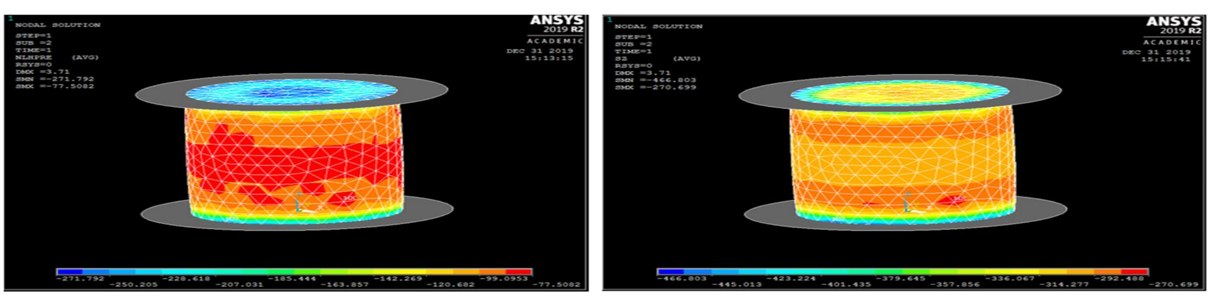


Fig1.10 Hydro Static Stress and Axial Stress of AA5083+9MMC for H/D ratio 1.0

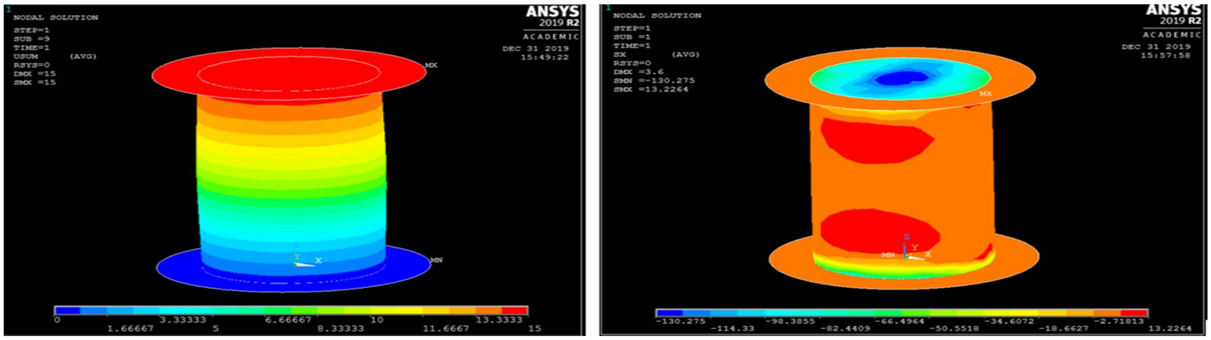


Fig 1.11 Maximum Displacement and Hoop Stress of AA5083+9MMC for H/D ratio 1.5

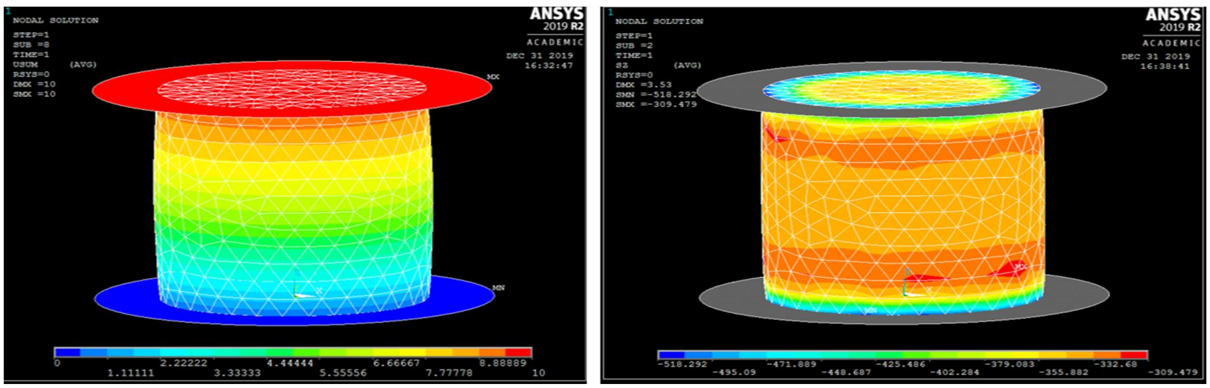


Fig 1.12 Maximum Displacement and Axial Stress of AA5083+12MMC for H/D ratio 1.0

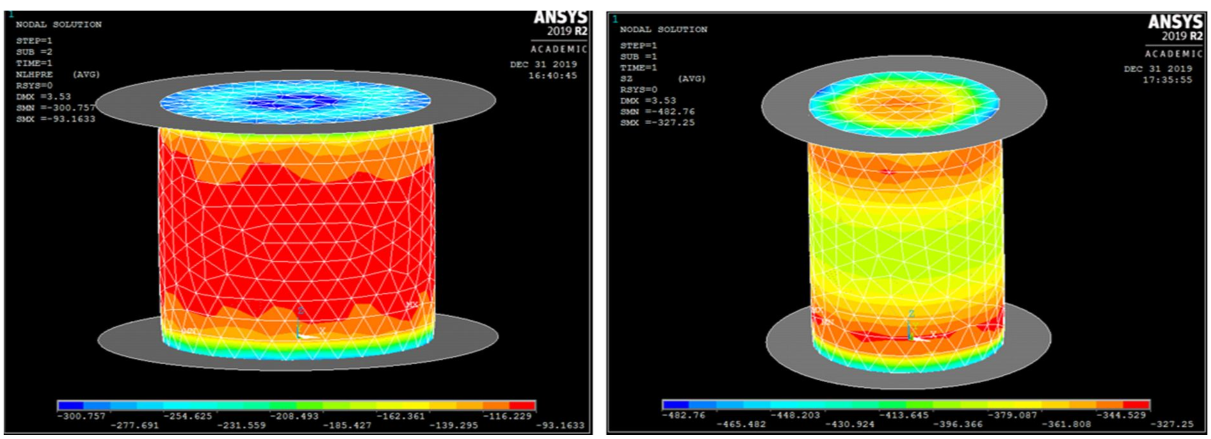


Fig 1.13 Hydro static Stress and Axial Stress of AA5083+12MMC for H/D ratio 1.0

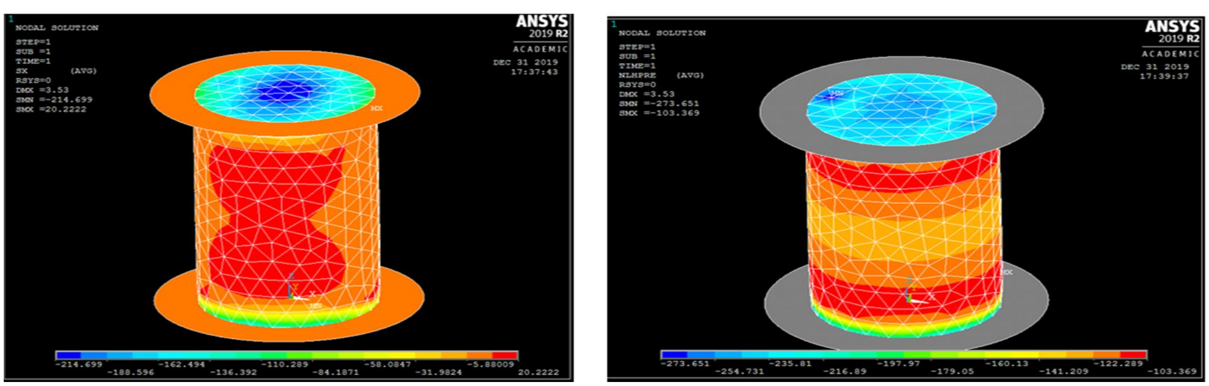


Fig 1.14 Circumferencial Stress and Hydrostatic Stress of AA5083+12MMC for H/D ratio 1.5

V. RESULTS AND DISCUSSIONS

The axial stress is increased for the H/D ratio 1.0 of composite metal matrix composites compare to base alloy AA5083 whereas for AA5083+9MMC composite very close to the effective strain line compare to other composites and base alloy it indicates the good ductile properties are presented. H/D ratio 1.5 the hoop stress is increased for 9 and 12 MMC compare to 6MMC and base alloy it indicates that they are exhibit the good plastic properties.

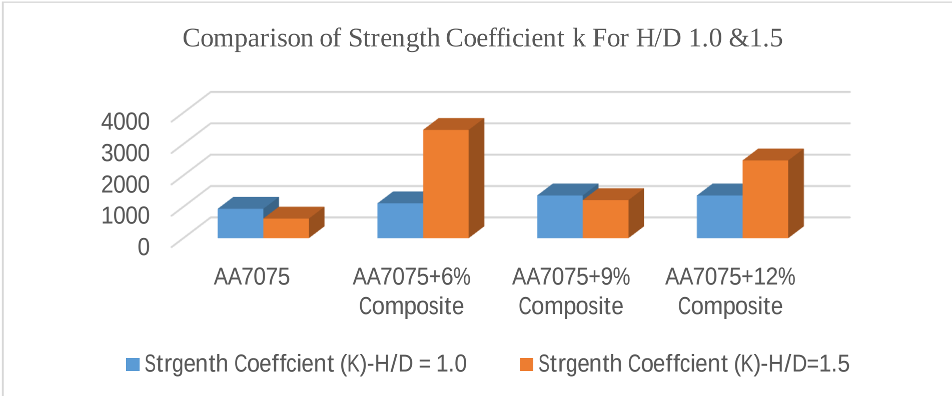


Table Comparison of Strength Coefficient k for H/D 1.0 &1.5.

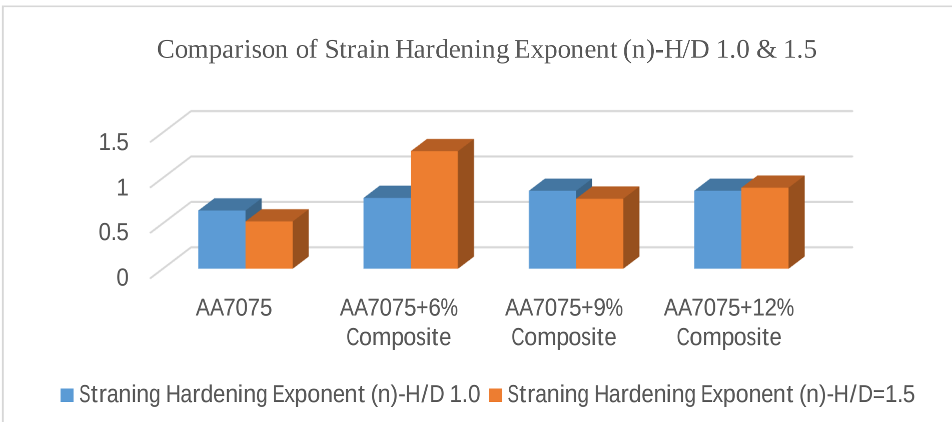


Table Comparison of Strain Hardening Exponent (n)-H/D 1.0 & 1.5.

Fig 1.5 to Fig 1.14 shows the true stress- strain curves, maximum displacement (up to 50% of deformation with respect to height), axial, hoop, and hydrostatic stress of Different aspect ratios of different composites of MMCs. The analytical results are very close to the ANSYS results for the upsetting of cylindrical samples of different MMCS.

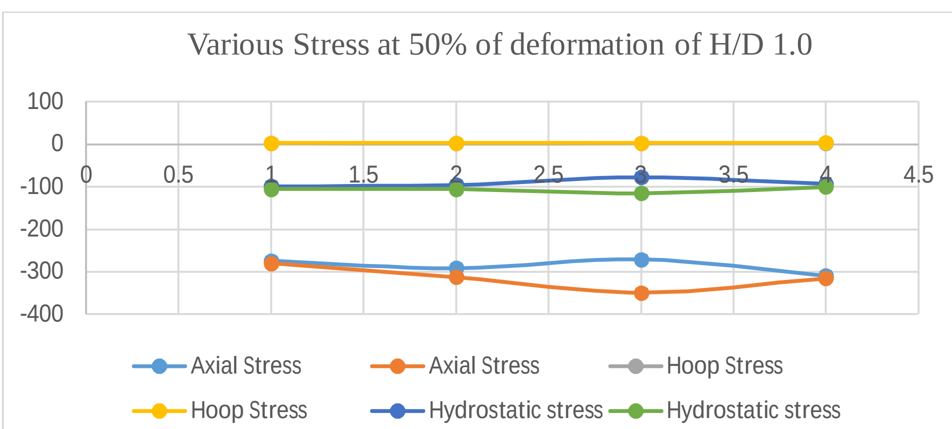


Fig 1.15 Various Stress at 50% of deformation of H/D 1.0

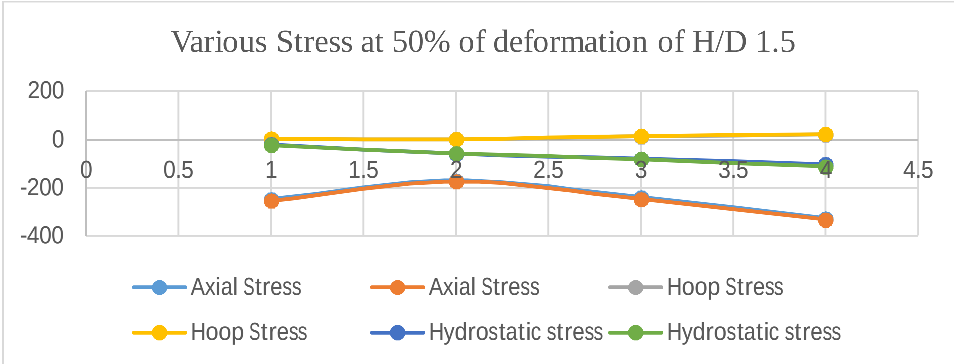


Fig 1.16 Various Stress at 50% of deformation of H/D 1.5

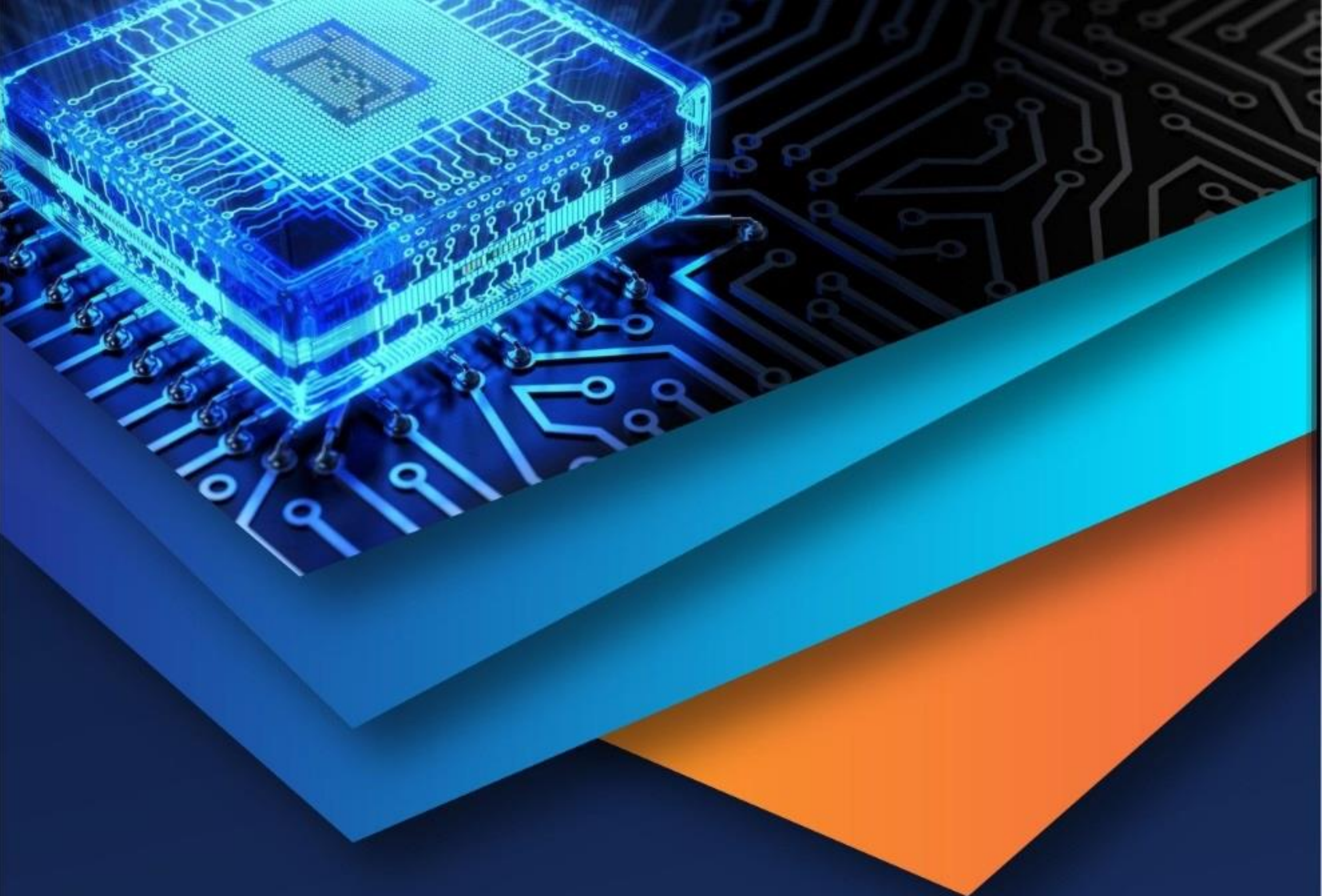
From Fig 1.15 to Fig 1.16 represents that various stress at 50% of deformation of the samples of H/D ratio 1.0 and 1.5 for base material and composites. The experimental results and ANSYS results at 50% of deformation of the samples are very close to each other. The hydro static stress was very low for H/D ratio 1.5 compare to H/D ratio 1.0, it indicates that the material was brittle in nature.

VI. CONCLUSION

The Upsetting preforms are fabricated successfully by stir casting Technique. The experimental work was done with the help of UTM (instron) for all the aspect ratios and different MMCs. The axial, hoop and hydro static stress are determined for the estimation of plastic behaviour of the metal using traditional equations. The ANSYS software was used to determine the stress for analysing the plastic flow of the material and the results are validated and are very close victim to each other. Results obtained by finite element analysis closely related to experiment results The values are thus validated by the FEM model

REFERENCES

[1] J. Babu Rao1, Syed Kamaluddin and N.R.M.R. Bhargava, "Optical strain measurements and its finite element analysis of cold workability limits of pure aluminium" International Journal of Engineering, Science and Technology Vol. 2, No. 12, 2010, pp. 1-13
[2] M.Haribabu, P.Chandrasekhar, D.Venkatesh, "Fabrication, Characterization and Damping Studies of A2024/Cu Particulate Reinforced Composites for Naval Applications" International Journal of Advances in Mechanical and Civil Engineering, ISSN: 2394-2827 Volume-4, Issue-2, Aprl.-2017
[3] R.V.Kiran, J Appa Rao, M.Gopi Krishna, "Deformation and Finite Element Flow Studies of Aluminium Based Copper Particulate Reinforced Metallic Composites" International Journal Of Advanced Research in Engineering & Management (IJAREM), Vol. 01 | Issue 08 | November 2015 |118.
[4] Haitham Mohammed Ibrahim, Dr. M.Gopi Krishna Mallarapu, "Deformation, Finite Element Studies and Fabrication of A6061 Alloy/Fly-Ash/B4c Hybrid Composites" Advanced Research Journals of Science and Technology, 2349-1845.
[5] J. Appa Rao, J. Babu Rao, Syed Kamaluddin and NRMR Bhargava, "Studies on Cold Workability Limits of Brass Using Machine Vision System and its Finite Element Analysis" Journal of Minerals & Materials Characterization & Engineering, Vol. 10, No.9, pp.777-803, 2011
[6] Swami Naidu Gurugubelli, A.V.S.S.K.S. Gupta and N.R.M.R. Bhargava, "The effect of magnesium concentration and deformation on the ageing behaviour of Al-Mg alloys" Int. J. Materials Engineering Innovation, Vol. 4, No. 1, 2013.
[7] D.Venkara Rao, N.Vijaya Kumar, J.Babu Rao, "Microstructure And Deformation Properties Of Alfa Composites", International Journal of Scientific & Engineering Research, Volume 7, Issue 7, July-2016,77 ISSN 2229-5518.
[8] Abdul AlKareem F. Hassan, Safa A. Saleh , Zainab H. Jibar, "Experimental and Theoretical Study of Hardness and Grain Size Variation in Cold Upset for Pure Copper Cylinder", Universal Journal of Mechanical Engineering 3(2): 34-46, 2015 http://www.hrpub.org DOI: 10.13189/ujme.2015.030202.
[9] Uppada Rama Kanth,Putti Srinivasa Rao,Mallarapu Gopi Krishna, "Mechanical Behaviour of Fly ash/B4c Particles Reinforced Al-Zn alloy Based metal matrix composites Fabricated By Stir Casting Method " Journal of Materials Research and Technology, (SCI)Elsevier Science Direct journal, ISSN: 2238-7854 ,e-ISSN: 2214-0697.
[10] U. S. Ramakanth, Putti. Srinivasa Rao, "Wear Behaviour of Al 5083/Fa/B4c Hybrid Composites" International Journal of Mechanical and Production Engineering research and Development (IJMPERD) ISSN(P): 2249-6890; ISSN(E): 2249-8001 Vol. 9, Issue 2, Apr 2019, 331-338



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY