ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Composite Poppet Valves Design and Testing

Kakarapalli.Divya Teja
M.Tech student
Godavari Institute of Engineering and Technology,
Rajahmundry,
Andhra Pradesh, India.

Sri.P.N.E.Naveen
Assistant professor
Godavari Institute of Engineering and Technology,
Rajahmundry,
Andhra Pradesh, India.

Mr. Prof.T.Jayananda Kumar
Professor
Godavari Institute of Engineering and Technology,
Rajahmundry,
Andhra Pradesh, India.

Abstract:

Poppet valve work well in engines because the pressure inside the combustion chamber pushes valve against the seat, sealing the chamber and preventing leaks during this cycle poppet valves are exposed to high temperature and pressure which will affect the life and performance of the engine. The aim of the project is to design an exhaust valve with a suitable material for a Four-stroke diesel engine by using fem analysis.

In poppet valve we have considered three different materials Al2O3, Carbon-epoxy, Carbon-carbon composite materials. In this we observe the results of original poppet valve as stress, strain and total deformation. These values are compared with the modified poppet valve design. The modified poppet valve design values are shown tremendous change in stress, strain and total deformation of the composite material.

I. INTRODUCTION

A poppet valve is even called as mushroom valve. These valves are basically used to control the timing of gas or vapor flow as well as the quantity which should flow into an engine. These valves consist of a hole, usually round or oval, and a tapered plug. As seen on the valves a disk shape on the end of a shaft is even called as a valve stem. The portion of the hole where the plug meets on the valve is referred as seat or even called as the valve seat. The shaft guides the plug portion by sliding through a valve guide. In exhaust conditions a pressure differential helps to seal the valve and in intake valves a pressure differential helps open it. Poppet valve is invented in 1770s, in which these valves in his steam engines by JAMES WATT.

INTRODUCTION TO POPPET VALVE:

Safety valves, which are usually of the poppet type, open at a predetermined pressure.

The movable element may be kept on its seat by a weighted lever or a spring strong enough to hold the valve closed until the pressure is reached at which safe operation requires opening.0n gasoline engines, poppet valves are used to control the admission and rejection of the intake and exhaust gases to the cylinders. The valve, which consists of a disk with a tapered edge attached to a shank, is held against the tapered seat by a compressed spring. The valve is raised from its seat by the action of a rotating cam that pushes on the bottom of the shank, permitting gas flow between a region, which leads to the intake or exhaust pipes, and to region, which leads to the cylinder.The working principles of a 4-stroke poppet valve IC engine cycle are shown schematically in Figure. These are basically divided in to four different strokes in IC engine, the clear description of the strokes is as follows:-

INTAKE STROKE:

In this stroke the piston moves from the TDC to BDC as shown In the figure, and while the piston moves from the top dead center to bottom dead center, the inlet valve gets opened, and the mixture of air and fuel enters in to the combustion chamber. As the mixture enters the combustion chamber the inlet valve gets closed. This is the first stroke which takes place in the combustion chamber

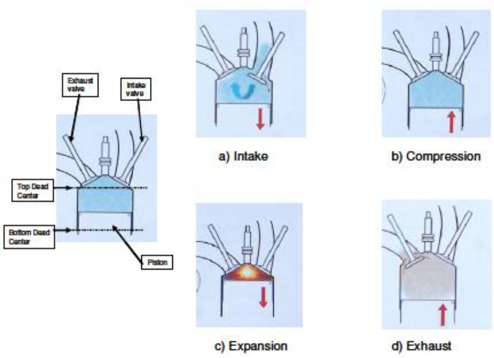
COMPRESSION STROKE:

This is the 2nd stroke in the cycle, as in this stroke the piston starts from the bottom dead center and moves towards the top dead center.

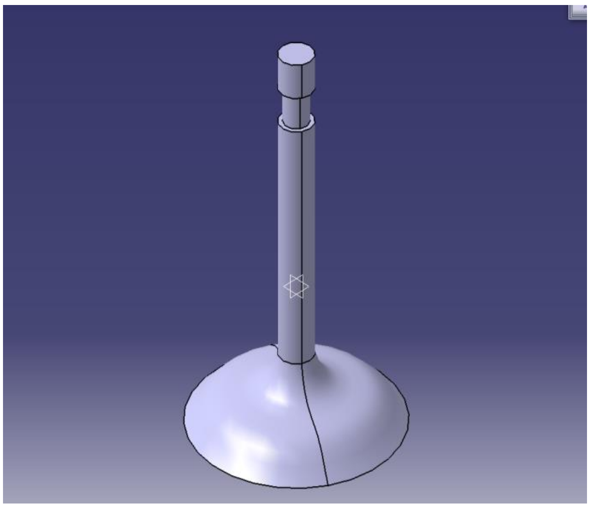
- Compression stroke (Figure 1-b), takes place when all the valves are in the closed position and the piston moves in the opposite direction, thereby compressing the gas in the chamber. At the end of this stroke a spark ignites the mixture or auto-ignition occurs.

- Expansion stroke (Figure 1-c). The gas mixture is ignited in the region of Top Dead Center (TDC). The energy released produces mechanical work, (pushing the piston away), heat and noise. This movement produces friction losses through the engine components and heat that is released to the surrounding metal, coolant and gas.

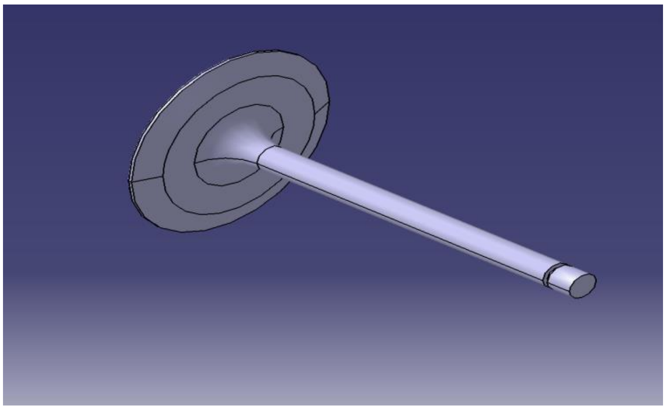
- Exhaust stroke (Figure 1-d), takes place when the Exhaust Valve Opens (EVO) and the piston moves towards the cylinder head, pushing the burnt gases out of the chamber. Once the Exhaust Valve Closes (EVC) and the piston is close to TDC, the cycle is complete and the intake stroke takes place again on the next cycle.



DESIGN OF ORIGINAL VALVE

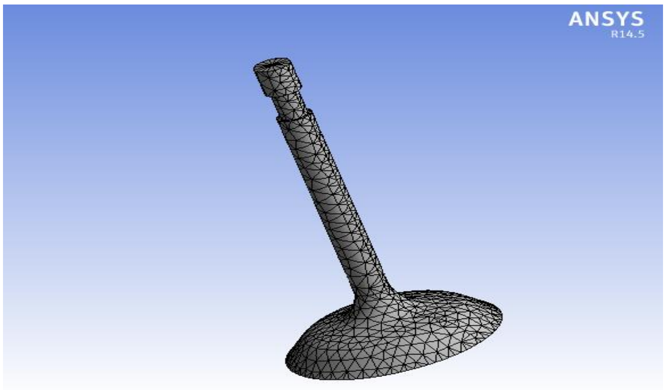


DESIGN OF MODIFIED VALVE

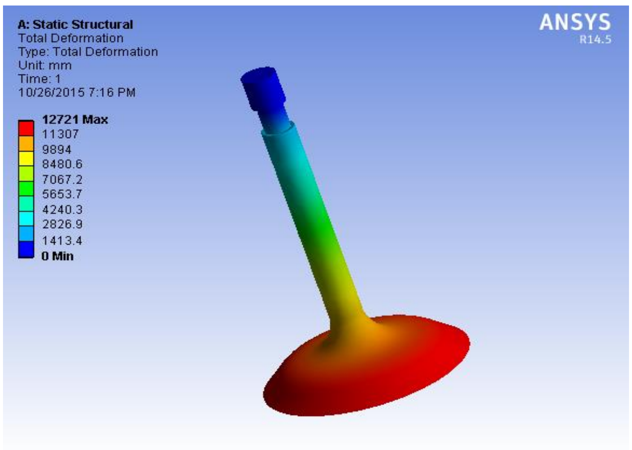


STRUCTURAL ANALYSIS POPPET VALVE WITH AL2O3 MATERIAL

Mesh modal

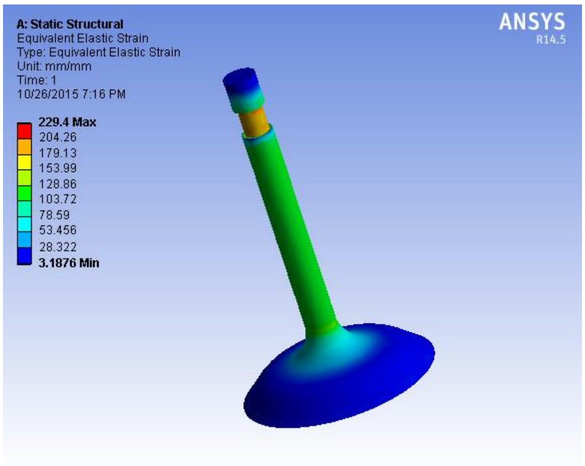


Deformation Results

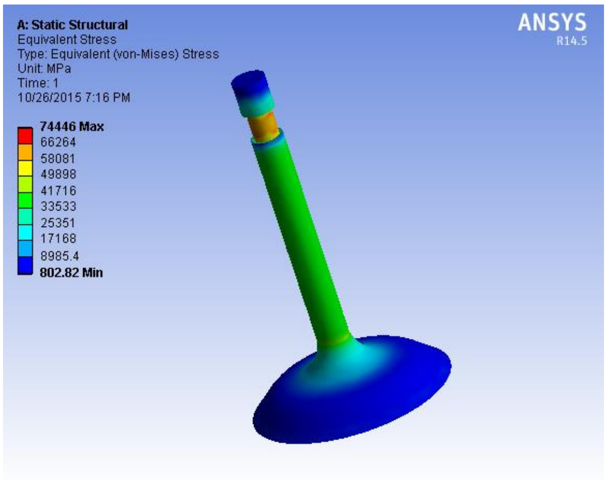


ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Strain

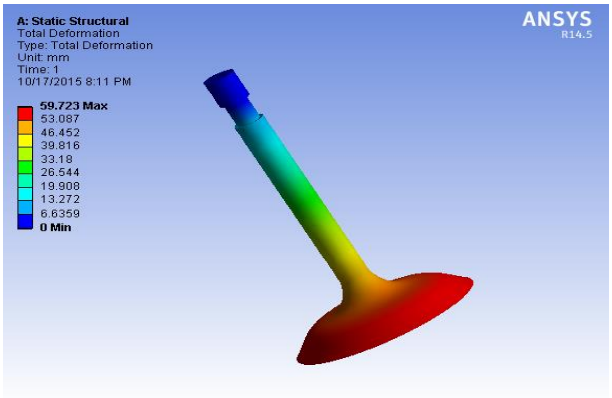


Stress

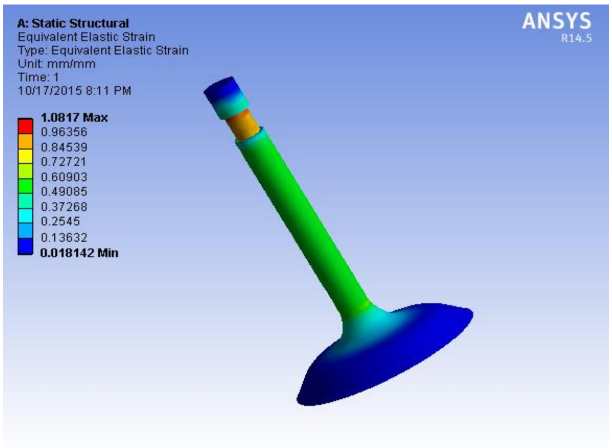


STRUCTURAL ANALYSIS POPPET VALVE WITH CARBON EPOXY MATERIAL

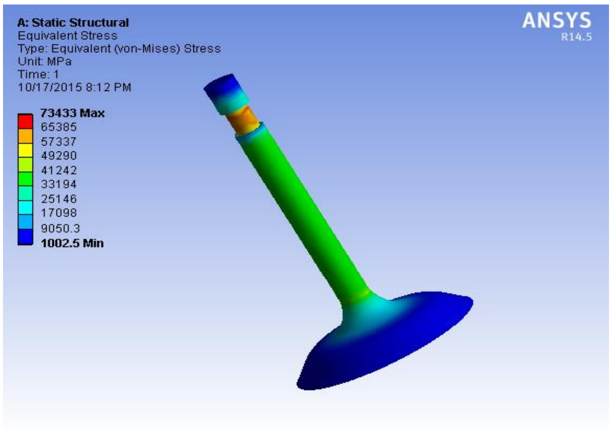
Deformation Results



Strain

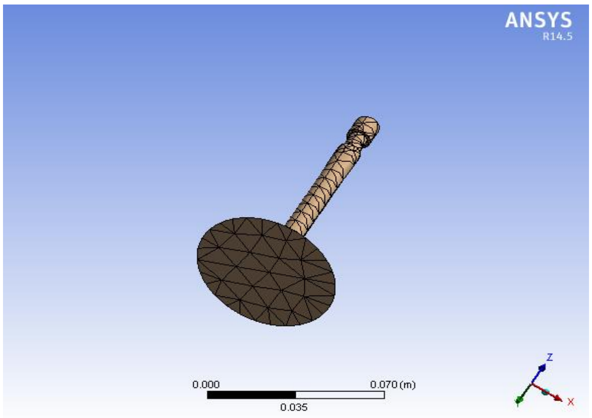


Stress



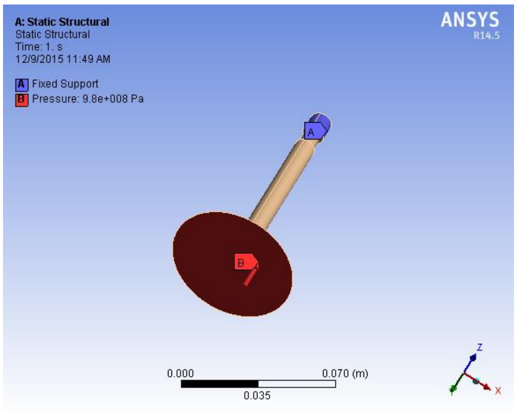
STRUCTURAL ANALYSIS POPPET VALVE WITH TECHNETIUM MATERIAL

MESH MODEL

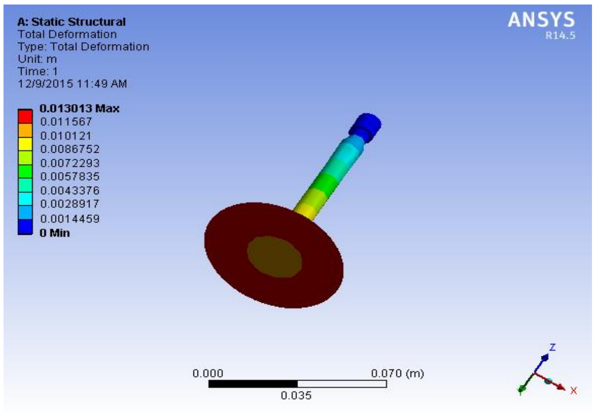


ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

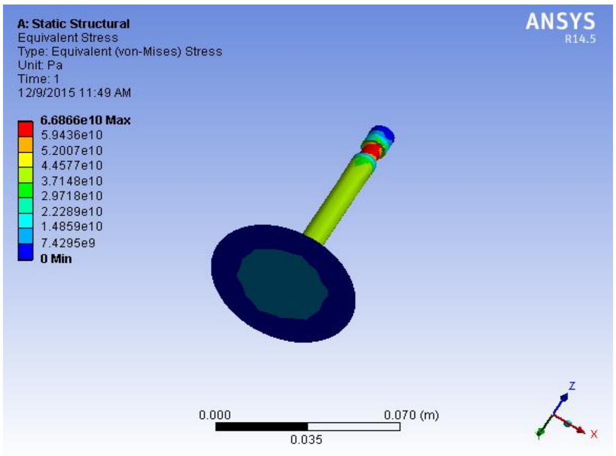
INPUT DATA



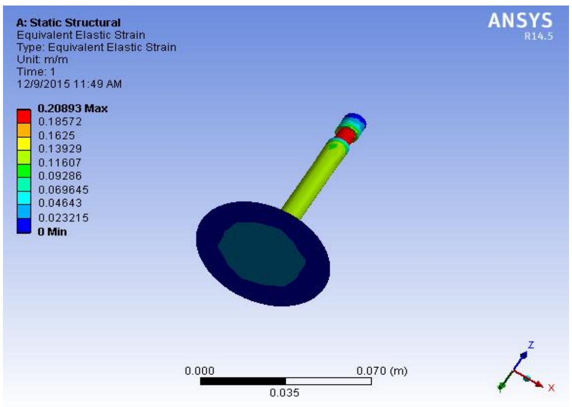
TOTAL DEFORMATION



STRESS

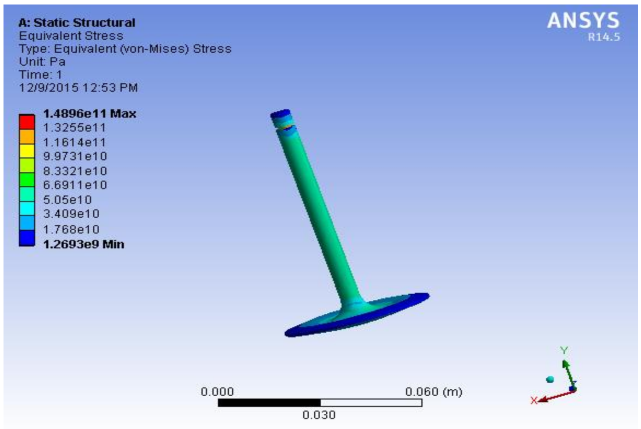


STRAIN

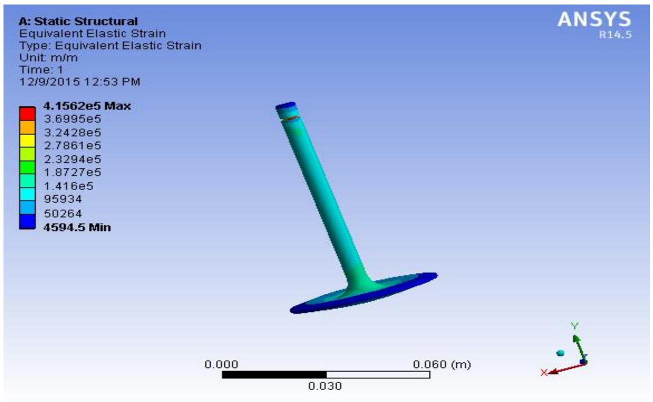


STRUCTURAL ANALYSISMODIFIED POPPET VALVE WITH AL2 O3 MATERIAL

STRESS

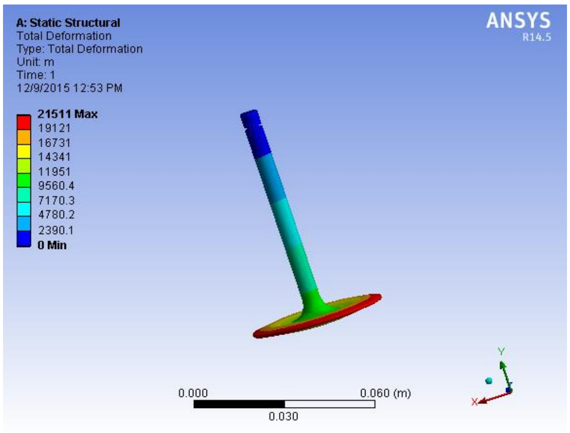


STRAIN



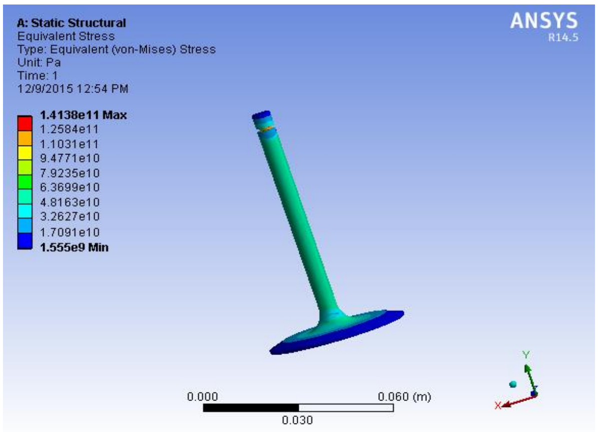
ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

TOTAL DEFORMATION

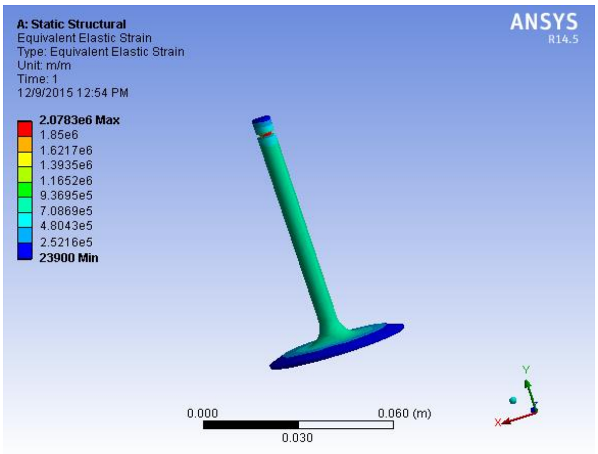


STRUCTURAL ANALYSIS MODIFIED POPPET VALVE WITH CARBON EPOXY MATERIAL

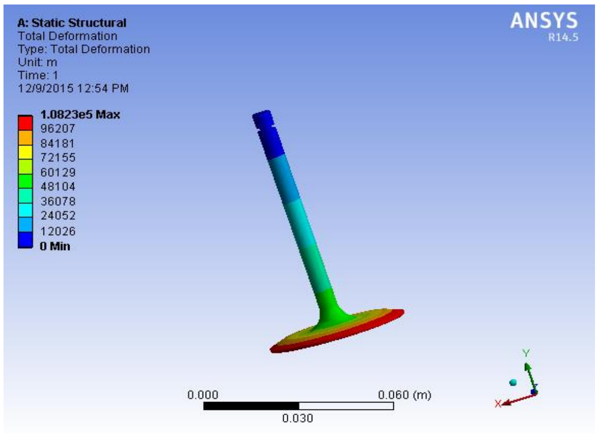
STRESS



STRAIN

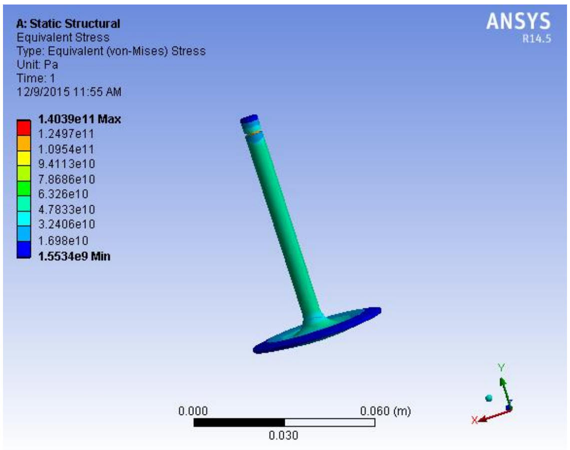


TOTAL DEFORMATION

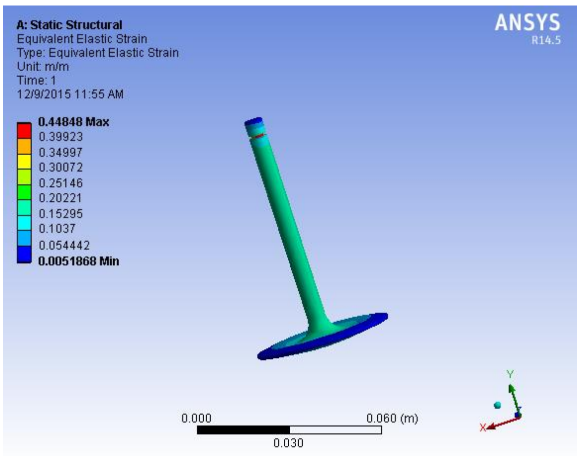


STRUCTURAL ANALYSIS MODIFIED POPPET VALVE WITH TECHNETIUM MATERIAL

STRESS

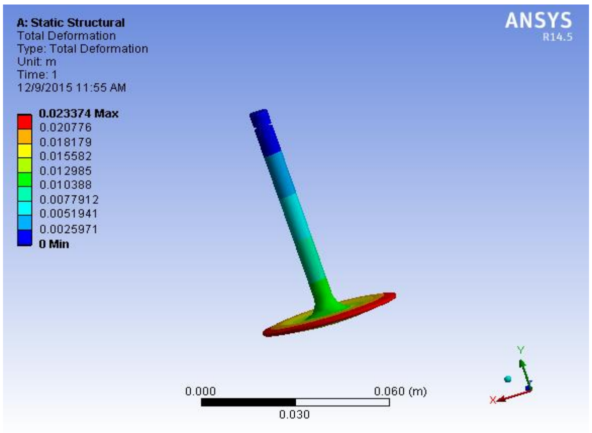


STRAIN



ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

TOTAL DEFORMATION



STRUCTURAL ANALYSIS OF POPPET VALVE

TABLE

	STRESS		STRAIN		TOTAL DEFORMATION
	MIN	MAX	MIN	MAX	
AL2O3	802.82	74446	3.1876	229.4	12721
CARBON EPOXY	1002.5	73433	0.018142	1.0817	59.723
TECHNETIUM	0	6.69E+10	0	0.20893	0.013013

STRUCTURAL ANALYSIS MODIFIED POPPET VALVE

TABLE

	STRESS		STRAIN		TOTAL DEFORMATION
	MIN	MAX	MIN	MAX	
AL2O3	1.27E+09	1.49E+11	4594.5	4.16E+05	2.15E+04
CARBON EPOXY	1.56E+09	1.41E+11	23900	2.78E+06	1.08E+05
TECHNETIUM	1.55E+09	1.40E+11	0.005187	0.44848	0.023374

CONCLUSION

In this thesis, we have taken a poppet valve and even we have modified the design of the poppet valve and in this project we have considered the design in Catia v5 software and analysis work is carried out in Ansys software. As here we have considered 3 materials al2o3, carbon epoxy, and technetium materials for analysis. As if we observe in the analysis all the results obtained are plotted in to tables and graphs, as if we compare the results obtained in the original model, we can conclude that stress (6.69E+10), strain (0.20893) and total deformation (0.013013) is having the lesser values. These results are obtained for the material technetium material. So here we can conclude that this material is the best material for the better output and life of the original model. As if we observe in the modified model in analysis all the results obtained are plotted in to tables and graphs, as if we compare the results obtained in the original model, we can conclude that stress (1.40E+11), strain (0.44848) and total deformation (0.023374) is having the lesser values. These results are obtained for the material technetium material. So here we can conclude that this material is the best material for the better output and life of the original model.So from all the results obtained, here we can conclude that the modified model with technetium material can withstand for long life and for better life output and better life efficiency.

REFRENCES

- Du, Hongliu, An E/H Control Design for Poppet Valves in Hydraulic System, *ASME, The Fluid Power and Systems Technology Division (Publication) FPST*, Vol. 9, p. 141-148, 2002
- Pfeiffer, Ferris, Dynamics and Stability Issues of Poppet Type Pressure Relief Valves, Master Thesis, *University of Missouri at Columbia*, 2004
- Stone, J. A., Discharge Coefficients and Steady-State Flow Forces for Hydraulic Poppet Valves, *Transactions of the ASME*, 82, p.144-154, March, 1960

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

- Funk, James E., Poppet Valve Stability, *Journal of Basic Engineering*, Ser. D, Vol.86, p. 207-212, June, 1964
- Kasai, Kohji, On the Stability of a Poppet Valve with an Elastic Support, *Bulletinof JSME*, Vol. 11, No.48, p.1068-1083, 1968
- Johnson, B. L. and D. E. Wandling, Actual Popping Pressure of a Relief Valve with a Real Helical Spring Under Dynamic Load, *Transactions of the ASME*, p. 1142- 1146, November, 1960
- Roberts, Brian J., Poppet Valves for Directional Control, *Machine Design, 60,18,ABI/INFORM Global*, p. 119-122, 11, August, 1988
- Johnston, D. N., K. A. Edge and N.D. Vaughan, Experimental Investigation of Flow and Force Characteristics of Hydraulic Poppet and Disc Valves, *ProcessingInstitution Mechanical Engineering*, Vol. 205, p. 161-170, 1991
- Ito, Kazumi, Koji Takahashi and Kiyoshi Inoue, Flow in a Poppet Valve, *JSME International Journal, Series B: Fluids and Thermal Engineering*, Vol. 36(1), p.42-50, 1993
- Shin, Yung C., Static and Dynamic Characteristics of a Two Stage Pilot ReliefValve, *Transactions of the ASME*, Vol.113, p. 260-268. , June, 1991

AUTHORS

1. **STUDENT**

Kakarapalli.Divya Teja received the B.Tech degree in mechanical engineering from Godavari Institute of Engineering and Technology, JNTU, Kakinada, Andhra Pradesh, India, in 2013 year, and perusing M.Tech in CAD/CAM from Godavari Institute of Engineering and Technology, Rajahmundry, Andhra Pradesh, India.

2. **GUIDE 1**

Sri.P.N.E.Naveen,M.Tech(Ph.D),Assistant professor,Godavari Institute of Engineering &Technology,Rajahmundry, Andhra Pradesh, India.

3. **GUIDE 2**

Prof.T.Jayananda Kumar Ph.D, professor, Godavari institute of Engineering &Technology, Rajahmundry,Andhra Pradesh, India.