International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 03 Issue 14
October 2016

Thermal Load Effect on Valve by Using Conventional and Blended Fuels

KODAMAGUNDLA VENKATESWARLU
DEPARTMENT OF MECHANICAL
NEWTONS INSTITUTE OF SCIENCE & TECHNOLOGY

Mr.P.SREENUVASULU
ASSISTANT PROFESSOR
DEPARTMENT OF MECHANICAL
NEWTONS INSTITUTE OF SCIENCE & TECHNOLOGY

ABSTRACT

The valves used in the IC engines are of three types: Poppet or mushroom valve or Sleeve valve or Rotary valve. Of these three types, Poppet valve is most commonly used. Since both the inlet and exhaust valves are subjected to high temperatures of 1930°C to 2200°C during the power stroke, therefore, it is necessary that the materials of the valves should withstand these temperatures. The temperature at the inlet valve is less compared to exhaust valve. Thus the inlet valve is generally made of nickel chromium alloy steel and exhaust valve is made of silchrome steel.

Automobile engines are usually petrol, diesel or gasoline engines. Petrol engines are Spark Ignition engines and diesel engines are Compression Ignition engines. Blended fuels are mixtures of traditional and alternative fuels in varying percentages. In this thesis, the effect of petrol, diesel and blended fuels on valve is studied by mathematical correlations applying thermal loads produced during combustion. Blended fuels are usually Ethanol fuels blended in different percentages. Percentages vary from 0%, 5%, 10% and 20%.

Internal combustion engines produce exhaust gases at extremely high temperatures and pressures. As these hot gases pass through the exhaust valve, temperatures of the valve, valve seat, and stem increase. To avoid any damage to the exhaust valve assembly, heat is transferred from the exhaust valve through different parts, especially the valve seat insert during the opening and closing cycle as they come into contact with each other.

In this thesis, a finite-element method is used for modeling the thermal analysis of an exhaust valve. The temperature distribution and resultant thermal stresses are evaluated. Detailed analyses are performed to estimate the boundary conditions of an internal combustion engine. In this thesis,

Pro/Engineer is employed for modeling and Ansys is used for analysis of the exhaust valve.

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.

The working principles of a 4-stroke poppet valve IC engine cycle are shown schematically in Figure 1. 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.

Poppetvalve

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

LITERATURE REVIEW

The greatest disadvantage of the poppet valve is that this type of valve often endures self-excited oscillation which is unstable. Therefore many basic works have been focused on poppet stability problems. In the early 1960's, J.A. Stone's work showedthat the downstream configuration (e.g., the length and diameter of the chamber) had a strong influence on the system stability. The smaller the chamber is, the higher the flow forces are. The steady-state flow force was mathematically modeled and experimentally shown to roughly match with the theoretical values, though test data were about 20 percent blew the theoretical values

CATIA

CATIA - which stands for Computer Aided Three-dimensional Interactive Application - is the most powerful and widely used CAD (computer aided design) software of its kind in the world. CATIA is owned/developed by Dassault Systems of France and until 2010, was marketed worldwide by IBM.

ANSYS

ANSYS is general-purpose finite element analysis (FEA) software package. Finite Element Analysis is a numerical method of deconstructing a complex system into very small pieces (of user-designated size) called elements. The software implements equations that govern the behaviour of these elements and solves them all; creating a comprehensive explanation of how the system acts as a whole. These results then can be presented in tabulated or graphical forms. This type of analysis is typically used for the design and optimization of a system far too complex to analyse by hand. Systems that may fit into this category are too complex due to their geometry, scale, or governing equations.

ANSYS is the standard FEA teaching tool within the Mechanical Engineering Department at many colleges. ANSYS is also used in Civil and Electrical Engineering, as well as the Physics and Chemistry departments.

ANSYS provides a cost-effective way to explore the performance of products or processes in a virtual environment. This type of product development is termed virtual prototyping.

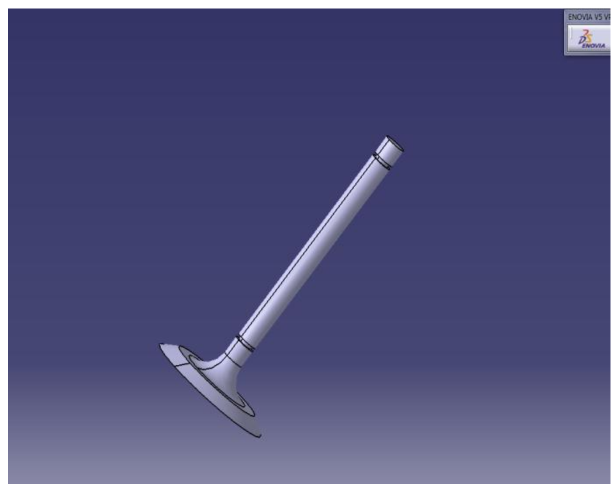
With virtual prototyping techniques, users can iterate various scenarios to optimize the product long before the manufacturing is started. This enables a reduction in the level of risk, and in the cost of ineffective designs. The multifaceted nature of ANSYS also provides a means to ensure that users are able to see the effect of a design on the whole behavior of the product, be it electromagnetic, thermal, mechanical et

ANALYSIS

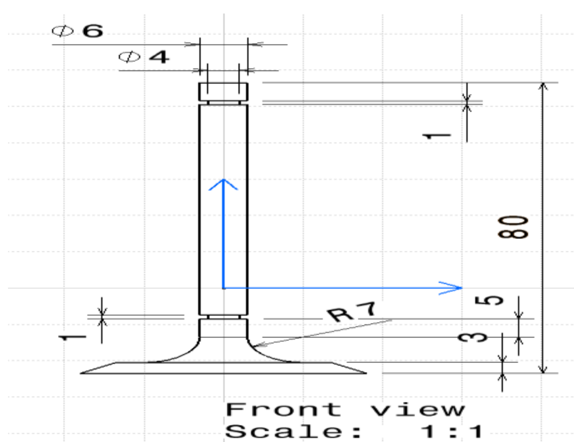
Introduction to finite element analysis

The basic concept in fem is that the body or structure may be divided into smaller elements of finite dimensions called "Finite Elements". The original body or the structure is then considered as an assemblage of these elements connected at a finite number of joints called "nodes" or "nodal points". Simple functions are chosen to approximate the displacements over each finite element. Such assumed functions are called "shape functions". This will represent the displacement with in the element in terms of the displacement at the nodes of the elements.

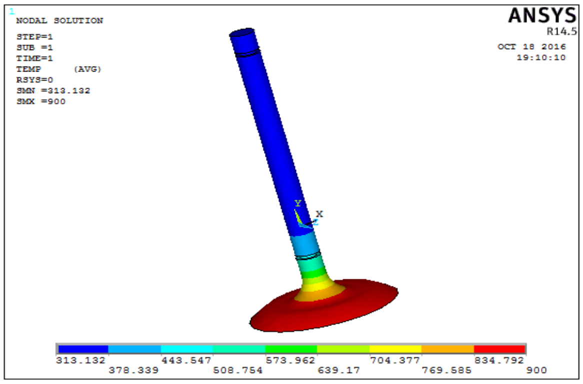
DESIGN OF VALVE



DRAFT OF VALVE

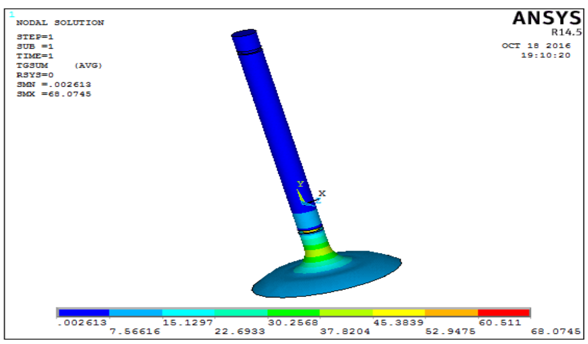


NODAL TEMPERATURE



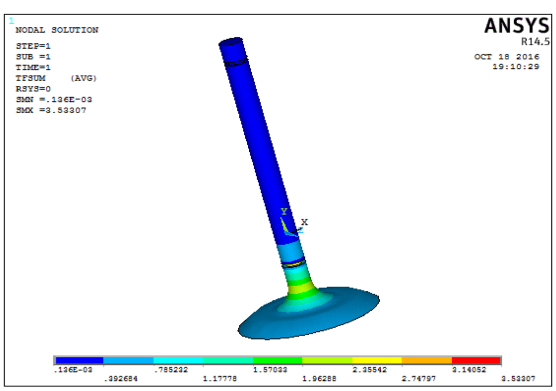
Post Processor→ Plot results→ Nodal solution→ DOF solution→Thermal Gradient→ TG vector sum→ Ok

THERMAL GRADIENT



Post Processor→ Plot results→ Nodal solution→ DOF solution→Thermal Gradient→ TF vector sum→ Ok

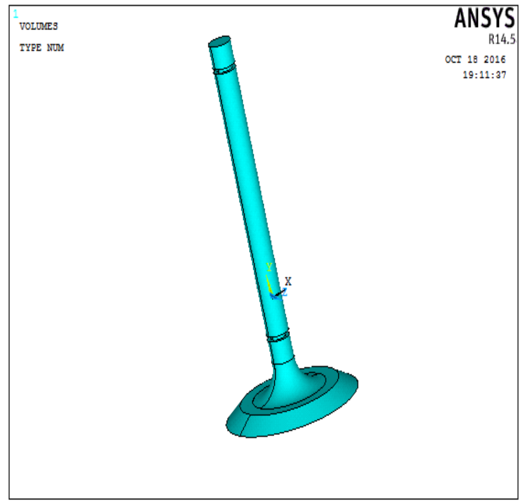
THERMAL FLUX



THERMAL ANALYSIS VALVEUSING THE MATERIAL SILICHROME STEEL ADDED WIH 20% BLENDED FUELS

File→Importing→IGES→ Browse →Select the .igs file →Open→Ok

Imported model



Preferences →thermal→Ok

Preprocessor→element type→add/edit→add→ Select solid 20 Node 186 →Ok→close

Preprocessor→Material type→ Material models→ Isotropic→ conductivity as 0.0519, specific heat as 599nad density as 0.00000787→Ok

Preprocessor→Meshing→Mesh tool→ Select Area Set →Pick All →Enter the edge length→Ok

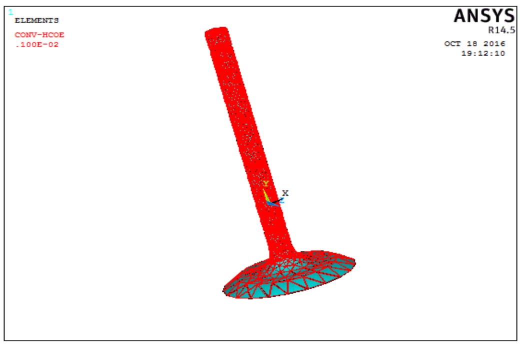
Meshed model

International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 03 Issue 14
October 2016

loads→Define Loads→Thermal→ Temperature→ On Areas→ Select the Areas→ Ok→ enter the temperature value as 960→Ok

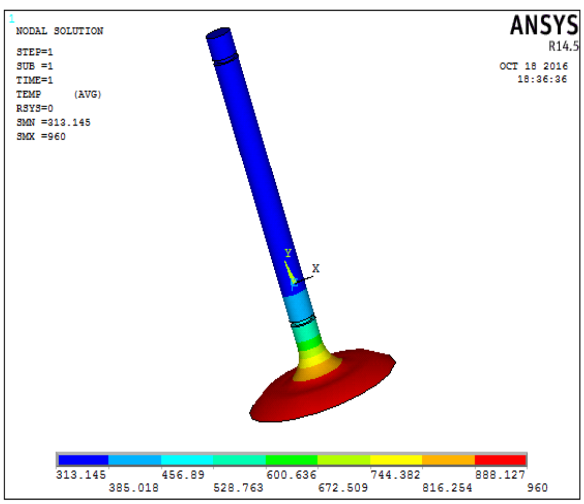
loads→Define Loads→Thermal→ convection→→ On Areas →enter film co efficient as 0.001 and Bulk temp as 313→ Ok

Loads applied model



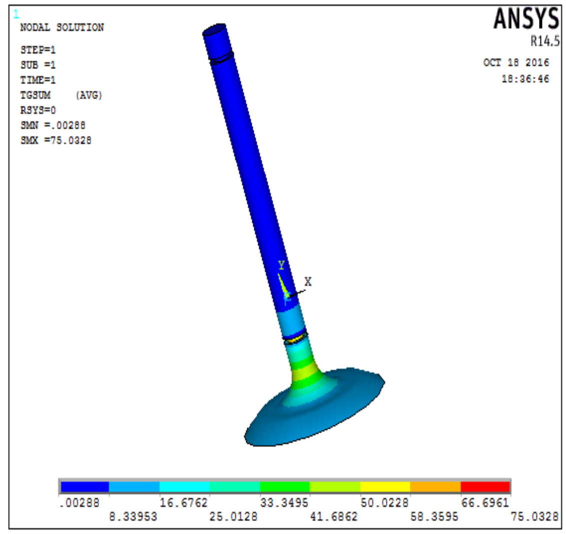
Post Processor→ Plot results→ Nodal solution→ DOF solution→ Nodal Temperature→ Ok

NODAL TEMPERATURE



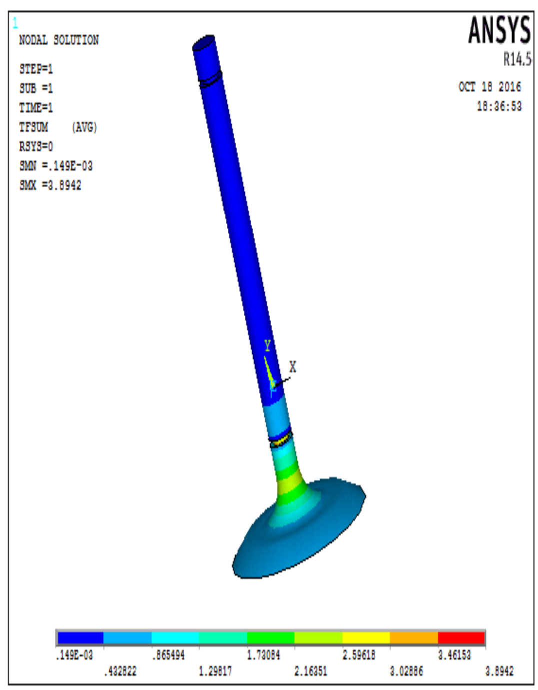
Post Processor→ Plot results→ Nodal solution→ DOF solution→Thermal Gradient→ TG vector sum→ Ok

THERMAL GRADIENT



Post Processor→ Plot results→ Nodal solution→ DOF solution→Thermal Gradient→ TF vector sum→ Ok

THERMAL FLUX



10% BLENDED FULES

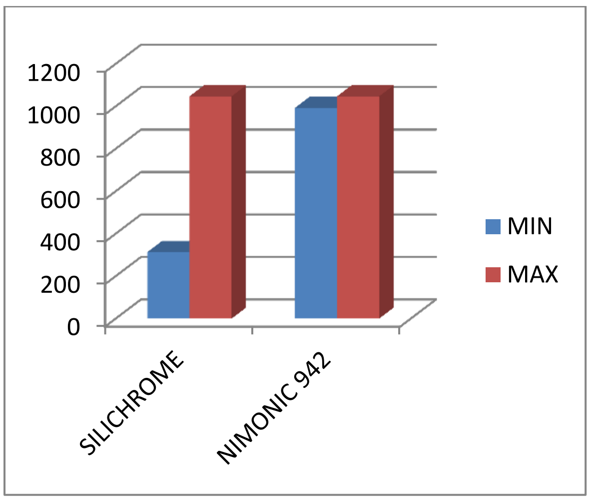
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 03 Issue 14
October 2016

TABLE

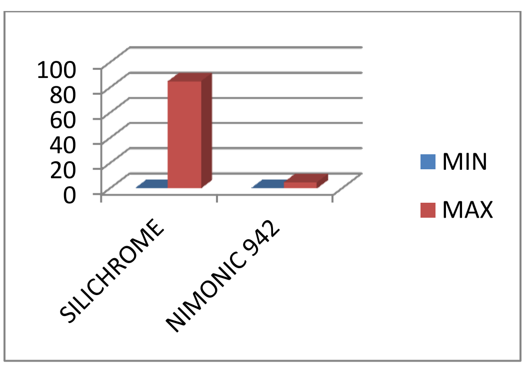
	TEMPERATURE		THERMAL GRADIENT		THERMAL FLUX	
	MIN	MAX	MIN	MAX	MIN	MAX
SILICHROME	313.164	1047	0.003267	85.1222	1.70E-04	4.41784
NIMONIC 942	992.49	1047	0.018206	4.91553	0.49521	133.703

GRAPHA

MINIMUM & MAXIMUM TEMPERATURE



MINIMUM & MAXIMUM THERMAL GRADIENT



MINIMUM & MAXIMUM THERMAL FLUX

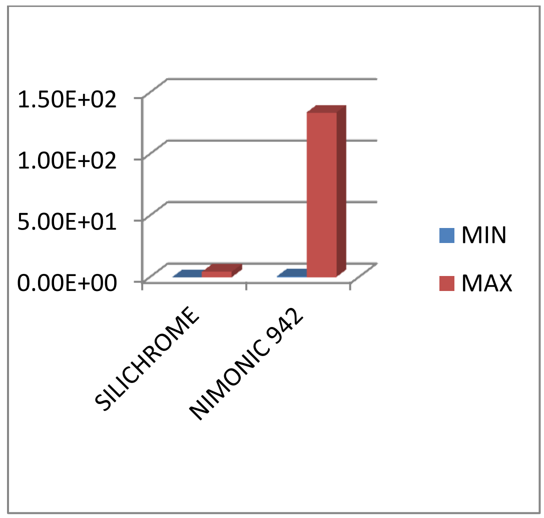
20% BLENDED FULES

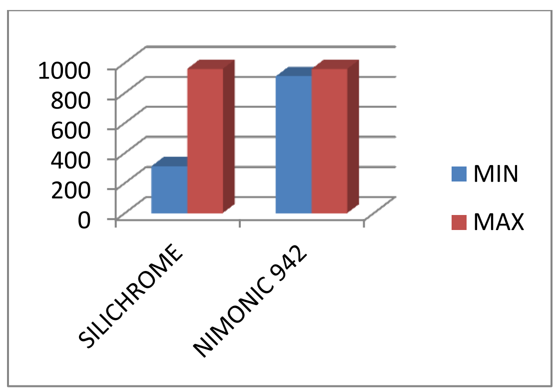
TABLE

	TEMPERATURE		THERMAL GRADIENT		THERMAL FLUX	
	MIN	MAX	MIN	MAX	MIN	MAX
SILICHROME	313.145	960	0.00288	75.0328	1.49E-04	3.8942
NIMONIC 942	911.951	960	0.016048	4.3329	0.436514	117.855

GRAPHA

MINIMUM & MAXIMUM TEMPERATURE





CONCLUSION

In this thesis, a finite-element method is used for modeling the thermal analysis of an exhaust valve. The temperature distribution and resultant thermal stresses are evaluated. Detailed analyses are performed to estimate the boundary conditions of an internal combustion engine. In this thesis, Pro/Engineer is employed for modeling and Ansys is used for analysis of the exhaust valve.

Here the effect of petrol, diesel and blended fuels on valve is studied by mathematical correlations applying thermal loads produced during combustion. Blended fuels are usually Ethanol fuels blended in different percentages. Percentages vary from 0%, 5%, 10% and 20%.

As per the obtained results, we have compared in the results in the graph we can observe that the silichrome steel with 0% blended fuels is having low thermal gradient (68.0745) and thermal flux (3.53307 when compared with the silichrome steel and nimonica 942 with 5%, 10% and 20% mixture of blended fuels.

So as per the results observed we can conclude that the value with silichrome steel mixture with 0% blended fuels is the best material for the better life of the IC engine.

REFERENCES

[1]. Alvydas Pikūnas, Saugirdas Pukalskas, Juozas Grabys - Influence of composition of gasoline – ethanol blends on parameters of internal combustion engines

[2.] Furey, R.L., Perry, K.L., 1991. Composition and reactivity of fuel vapor emissions from Gasoline-oxygenate blend. SAE Paper 912429.

[3]. Coelho, E.P.D., Moles, C.W., Marco Santos, A.C., Barwick, M., Chiarelli, P.M., 1996. Fuel injection components developed for Brazilian fuels. SAE Paper 962350.

[4]. Naegeli, D.W., Lacey, P.I., Alger, M.J., Endicott, D.L., 1997. Surface corrosion in ethanol fuel pumps. SAE Paper 971648.

[5]. Salih, F.M., Andrews, G.E., 1992. The influence of gasoline/ethanol blends on emissions and fuel economy. SAE Paper 922378, SAE Fuel and Lubricants Meeting.

[6]. Abdel-Rahman, A.A., Osman, M.M., 1997. Experimental investigation on varying the compression ratio of SI engine working under different ethanol–gasoline fuel blends. International Journal of Energy Research 21, 31–40.

[7]. Gorse Jr., R.A., 1992. The effects of methanol/gasoline blends on automobile emissions. SAE Paper 920327.

[8]. Bureika G. Research on the feasibility to use the ethanol as transport machine fuel/ doctoral dissertation. Vilnius. 1997.

[9]. Palmer, F.H., 1986. Vehicle performance of gasoline containing oxygenates. International conference on petroleum based and automotive applications. Institution of Mechanical Engineers Conference Publications, MEP, London, UK, pp. 33–46.

[10]. Bata, R.M., Elord, A.C., Rice, R.W., 1989. Emissions from IC engines fueled with alcohol–gasoline blends: a literature review. Transactions of the ASME 111, 424–431.

[11]. Alexandrian, M., Schwalm, M., 1992. Comparison of ethanol and gasoline as automotive fuels. ASME papers 92- WA/ DE-15.

[12]. Rice, R.W., Sanyal, A.K., Elrod, A.C., Bata, R.M., 1991. Exhaust gas emissions of butanol, ethanol and methanol–gasoline blends. Journal of Engineering for Gas Turbine and Power 113, 337–381.