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Analysis of C.I. Engine Piston Crown Coated with High Copper- Boride Alloys

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ABSTRACT: A mutual component in generators, engines and gas compressors is a piston. It is cylindrical in shape with piston rings and gas-tight. Engine pistons are one of the vehicle and other elements among the industry's most common parts. At one end of the connection rod at the other end of the connector rod is bound by the piston ring. Pistons are subjected to fuel combustion and high temperature combustion chamber forces created by hot burned gasses. The project's main aim is to build a column with a C.I crown for two Copper and Boride Alloy materials as coated and non-coated material. The piston designs are designed with the program NX8.0. The designs are tested by adding temperatures to the state thermal analysis. The findings will be tested by evaluating the temperature and the heat flow to assess the best piston output with a crown. ANSYS program performs thermal analysis.

KEYWORDS: Piston with crown, Copper and Boride alloys, heat flux, temperature Thermal analysis, ANSYS software.

I.COPPER BORIDE ALLOY

Copper alloys provide a suite of infinitely recyclable materials offering numerous property combinations tailored to a wide range of applications that promote and improve our everyday lives Copper performance can be extended to fit many industrial applications and high-tech goods. This is done through the alloying process: creating a solid material from two or more different metals. Combining copper with other metals will create a variety of copper alloys that suit almost any application.

Borides properties

Borides do not adhere to the normal valence principles, either in stoichiometry or in structure. Metal boride stoichiometry varies from compounds with low boron content, such as M5B, to compounds that are highly rich in boron, such as MB66–MB99 where M represents a metal. Within this compositional spectrum, the crystallographic structure of the borides changes The spatial distribution of boron atoms is characteristic of all these compounds, moving from isolated boron atoms to pairs, chains, and three-dimensional linked networks in the boron-rich borides, raising the number of boron-boron interactions with the boron content.

Table: Copper and boride alloy material properties

Parameters	Copper alloy	Boride Alloy
Thermal conductivity	225	34.59
Co efficient of thermal	17.5	12.8
Modulus of elasticity (Gpa)	8.81	7.87
Density (g/cm ³)	94	264-331
Hardness (HB)	71	130-135

Finite Element Method

The definition of FEM is unknown, according to her own words. The underlying principle is only a limited number of measurement points and interposing the quantities for the whole area (surface or quantity). It is a computational approach that uses mathematics and provides approximate results on a real problem.

Problem solving by FEA

FEA 's approach to a systemic issue requires: Read about the topic

✚ Mathematical process planning Resolution of the equations Monitor and confirmation tests

✚ Learning about the problem

The physics and existence of the problem must be understood and categorized. The first step is to define the problem. An engineer must then define the issue with the following questions.

Preparing and solving mathematical models

The Mathematical Models FEA is implemented. Simulation is FEA, and not reality. If the mathematical model is incorrect or insufficient, it will may not suit the physical reality with very exact FEA. Set a model research question, consider the physical essence of the problem. When the basic structure of the problem is understood, it is possible to establish an implementation model.

Excluding superfluous data and all critical characteristics. Information which are irrelevant can be overlooked. An unnecessarily complicated model analysis would be permitted. Decide which characteristics are important for the specific reason. This gives us ample precision to obtain the results.

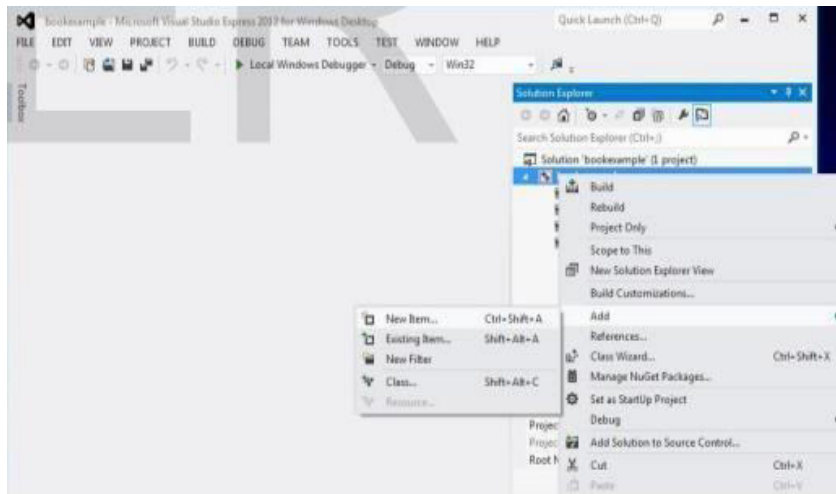
When describing and approximating the geometric form by chosen differential equations and limit conditions, a mathematical model is.

Therefore geo-metrical anomalies may be overlooked, loads may be considered concentrated, supports may be fixed and material idealized as homogenous, isotropic, and linearly elastic.

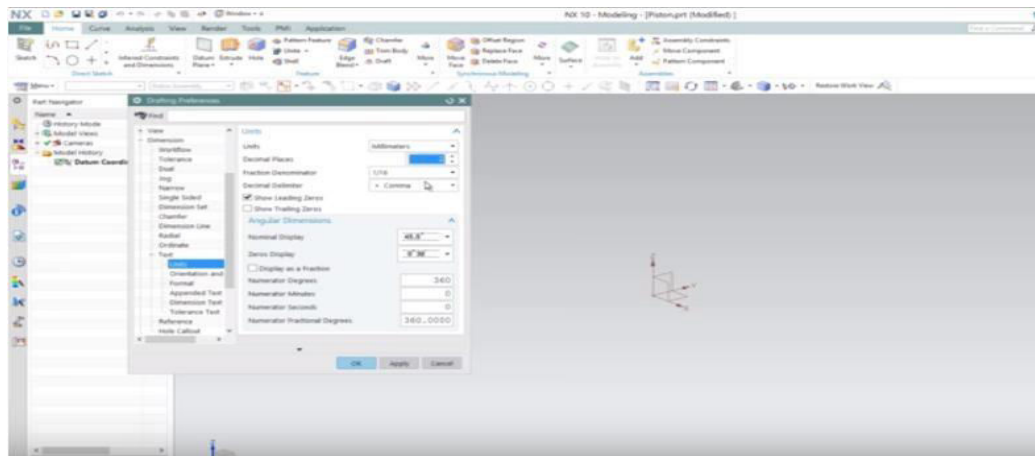
We should agree that behavior is characterized by theory of beams, flat- bending theory, flat-elasticity equations and all other theories for analysis by scale, loading and boundaries of this idealisation. The modeling decisions are focused on the information provided, the accuracy, the estimated FEA cost and its capabilities and constraints. Final decisions on modeling will be preliminary. Results from the first FEA would possibly imply refinement, geometry, theory, etc

II.MODELING PROCEDURAL STEPS IN NX 8.0

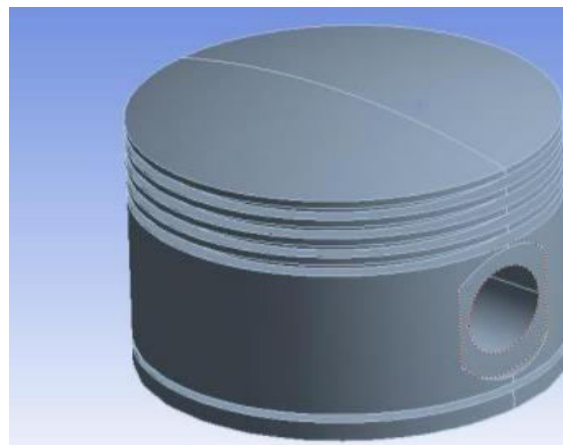
The NX Simulation Appliance enables both parametric and 3-dimensional surface simulation functions to be performed. A variety of tools for the development of 2D and 3D wireframe models and association-based solid modeling are available in an NX modelling application3D Free-Form Surface Modeling We may also perform more complex modelling function, such as complex surface modeling and solid modeling. The Sketch Curve Toolbar offers software to create and edit basic 2D Geometry, construction equipment like Line and Circle, and editorial software like Trim and Extend. The Profile tool helps us to create lines and/or arcs together. The NX environment is executed from the start menu as follows



The scoring environment can be started from the Mechanical design component assembly. The XY plane is chosen as the basic scoring plane from the scorer system. The required sketch is created as follows from the toolbar profile.



If the profile diagram is constructed according to the above dimensions. The model is limited by valid constraints and dimensions as outlined above. When a model is adequately constrained, it is impossible to leave the design process again.



PISTON MODEL VIEW NX 8.0

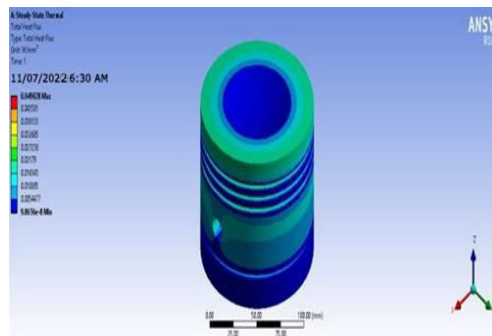
With the aid of the toolbar button, the minimal style is rotated. The necessary piston is produced once the drawing is turned to 360 deg. The pocket is eventually designed as shown. The model can be stored as the component file Catia,

or can be exported as the file IGES, a fair 1 less data loss between the aided program Once the piston geometry model has been completed.

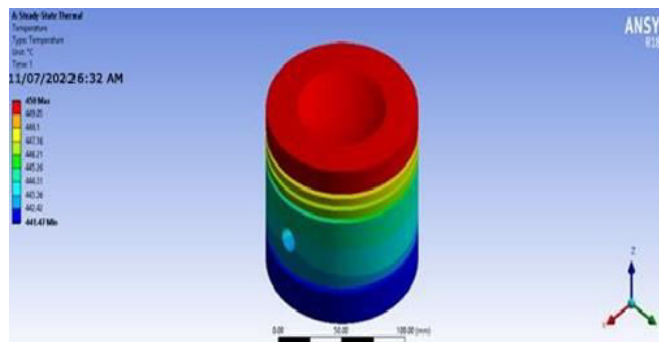
IV. RESULTS AND DISCUSSIONS

Analysis should break a complicated subject or object into smaller parts to help explain it. This model has been studied thermally and accompanied by static analysis called a hybrid analysis. The following are explained in the thermal analysis measures.

NON COATED PISTON MATERIAL AS COPPER:

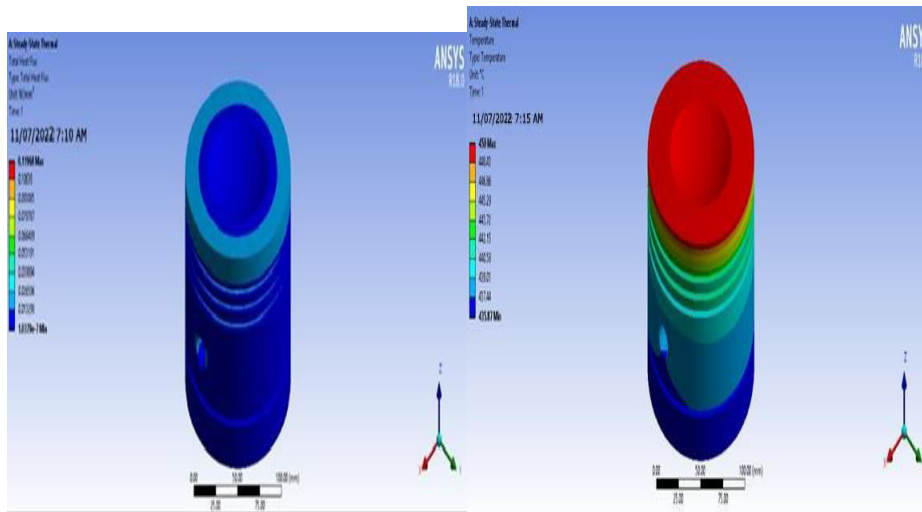


total heat flux piston with COPPER



**temperature variance piston with COPPOR

Non coated piston Material as Boride:



Total heat flux piston with Boride

COATED PISTON MATERIAL AS COPPER:

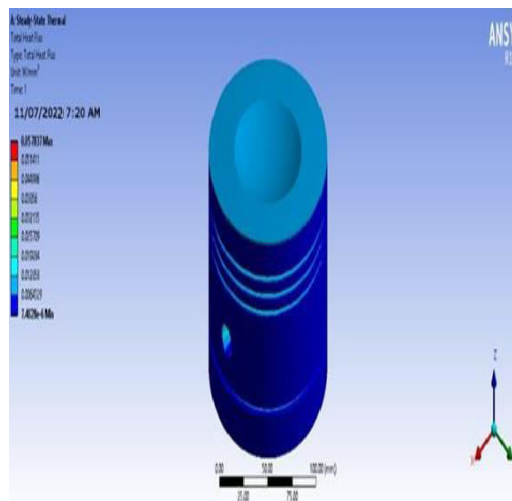


Figure: Shows total heat flux piston with crown of COPPER

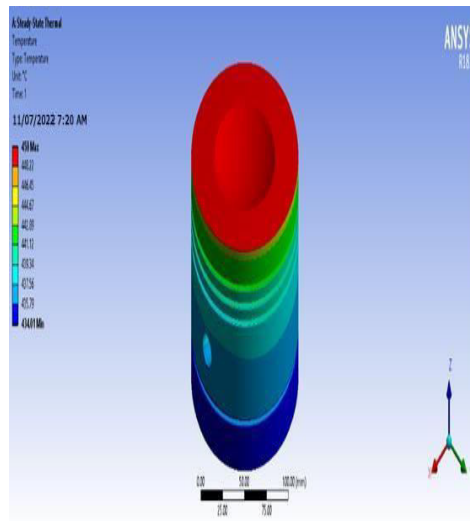
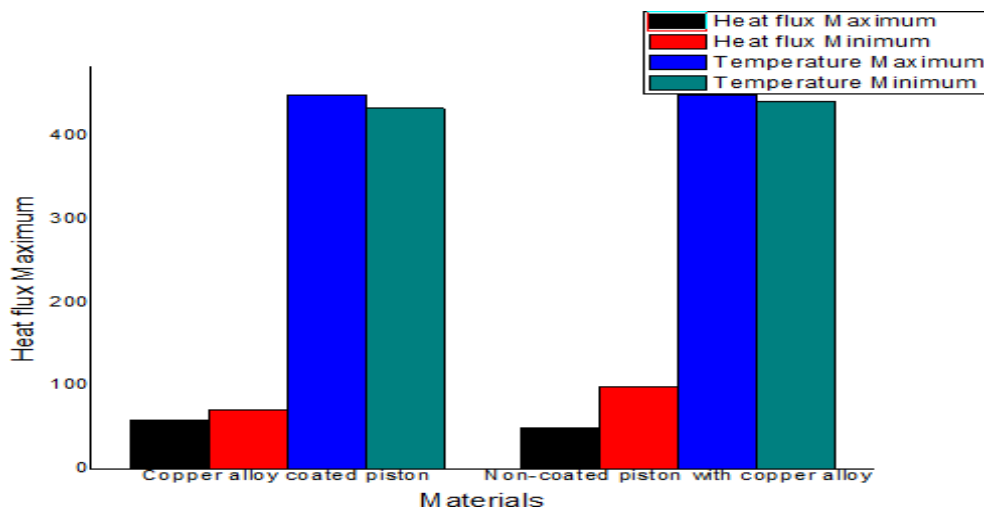


Figure: shows total temperature piston with crown of COPPER

COATED PISTON MATERIAL AS BORIDE:

TABLE: Copper Alloy Coated Piston and Non -Coated Piston Alloy Maximum And Minimum Values

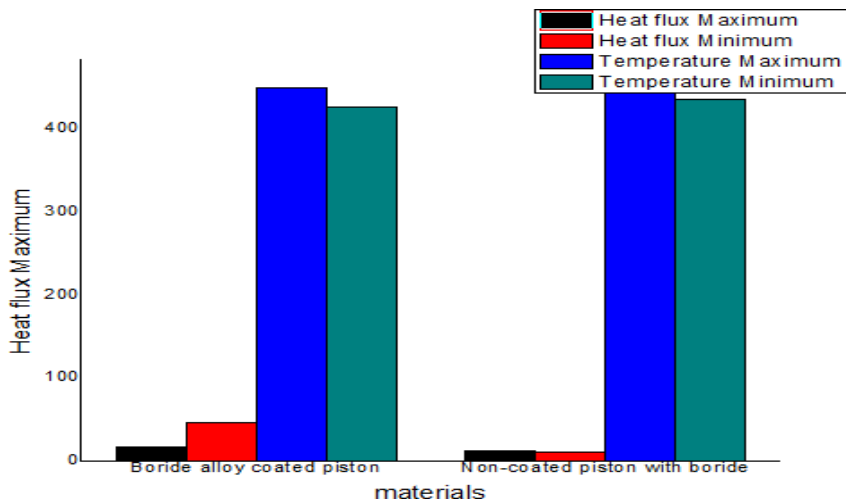
Materials	Heat flux		Temperature	
	Maximum	Minimum	Maximum	Minimum
Copper alloy coated piston	0.057837	7.0428e-6	450	434.01
Non-coated piston with copper alloy	0.049025	9.8654e-8	450	441.47



Graph: Copper alloy coated piston and non -coated piston alloy maximum and minimum variations

TABLE: Boride Alloy Coated Piston and Non-Coated Piston Alloy Maximum And Minimum Values

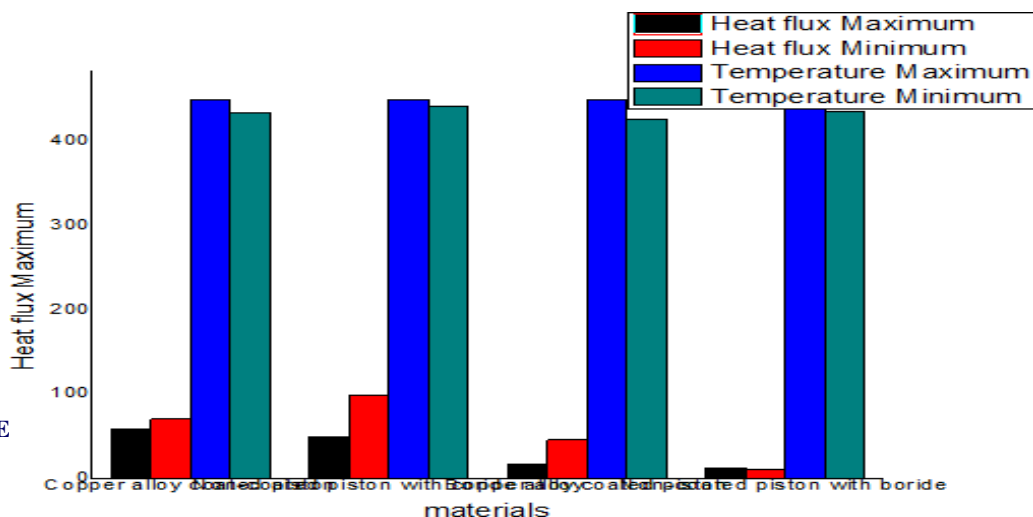
Materials	Heat flux		Temperature	
	Maximum	Minimum	Maximum	Minimum
Boride alloy coated piston	0.15799	4.5087e-6	450	427.38
Non-coated piston with Boride	0.11968	1.0379e-7	450	435.87



Graph: Boride alloy coated piston and non-coated piston alloy maximum and minimum variations

Table: Comparison of copper and boride alloys coated and non-coated piston values

Materials	Heat flux		Temperature	
	Maximum	Minimum	Maximum	Minimum
Copper alloy coated piston	0.057837	7.0428e-6	450	434.01
Non-coated piston with copper alloy	0.049025	9.8654e-8	450	441.47
Boride alloy coated piston	0.15799	4.5087e-6	450	427.38
Non-coated piston with boride	0.11968	1.0379e-7	450	435.87



Graph: Comparison of copper and boride coated and non-coated piston variations

V. DISCUSSIONS

It is noted that the coated Copper alloy also has better results than the coated Boride alloy as well as the non-coated Copper alloy with better results than the non-coated Boride alloy so here we have found that

COATED COPPER:

When a piston is coated with Copper and subject to heat flux the values obtained are as below

Heat flux : 0.057837max
: 7.0428e-6 min

When a piston is coated with Copper and subject to temperature the values obtained are as below Temperature:
450⁰c max

: 434.01min NON COATED COPPER:

When a piston is with non-coated with Copper and subject to heat flux the values obtained are as below

Heat flux : 0.049025max
: 9.8654e-8 min

When a piston is non-coated with Copper and subject to temperature the values obtained are as below
Temperature: 450⁰c max
: 441.47 min

COATED BORIDE:

When a piston is coated with Boride and subject to heat flux the values obtained are as below

Heat flux: 0.15799Max
: 4.5087e-6 min

When a piston is coated with Boride and subject to temperature the values obtained are as below
Temperature: 450⁰c max
: 427.38 min

NON-COATED BORIDE:

When a piston is non-coated with Boride and subject to heat flux the values obtained are as below

Heat flux: 0.11968 Max
: 1.0379e-7min

When a piston is non-coated with Boride and subject to temperature the values obtained are as below
Temperature: 450⁰c max
: 435.87 min

VI. CONCLUSION

Two different gasoline diesel engines experimentally studied combustion, performance parameters and exhaust emissions. The following results were taken from this:

- ❏ CI-coated and Copper and Boride-coated CI motor respectively improved heat flux by 10.98% and 18.62% in Copper and Boride alloys
- ❏ Boride is readily available on the market and its coating is also simple in crown area and cost effective compared to copper alloy.
- ❏ Boride compared, better than Copper-CI combustion alloy engine by testing the literature, the majority of good results in 0,3 mm thickness layers were obtained, which is the result of the study of the same thickness Complex load analysis can be conducted with boride load conditions as crown and coated material for further study.

The power of the CI engines is greater than the base engine. In the CI engine heat loss in the exhausts and heat loss in the cooling water was noticed more than in the base engine. In gasoline engine, heat losses as unknown have been

reduced by 55%. For CI engines CO, HC, the fumes level decreased, and the NO_x rates increased with the CI engine. After all, the heat balances have improved. In contrast to the copper and boride alloy coated CI engine, the noise level was found to be satisfactory for both types of ciper engines and improved combustion, output and exhaust emissions.

FUTURE SCOPE

The piston boride on the crown of the piston is more efficient with coating than the uncoated piston which saves on piston fuel consumption. This energy savings increases the motor's overall efficiency.

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