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STUDY AND PERFORMANCE ANALYSIS OF A CERAMIC COATED COMBUSTION CHAMBER FOR THERMAL EFFICIENCY

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ABSTRACT
Combustion chamber with ceramic material coating is defined as the process of alternating the Material concept to get high combustion efficiency. The aim of ceramic chamber coating is to Develop high combustion with engines designed to advanced material concept substantially During various combustion conditions. Gas turbine combustion chambers can be generally Classified as Can, Annular, Can Annular, etc. Most of the Gas turbine combustion chamber Concepts are based upon size and injector position, chamber material but till now not implemented on ceramic material coating, ceramic material include the combined material. There is few researches being carried in combustion chamber with new concept. Here, in our concept, the ceramic material (silicon carbide (Sic)) is used in combustion chamber to coat for conventional chamber material to get high temperature combustion exit gas and to get high thrust. In this project, the combustion chamber with ceramic material coating is designed by using CATIA. In order to predict the chamber with ceramic, the numerical analysis of ceramic chamber coating by using ANSYS. The increment of combustion efficiency will be expect by using ceramic combustion chamber coating in gas turbines, which means get more Thrust.

Keywords- Combustion efficiency, Combustion chamber, Thrust, Ansys.

1. INTRODUCTION
This development of the gas turbine combustion chamber as an aircraft and power plant has been so rapid development has been increased gradually in early to years. The challenges in designing high performance combustion systems have not changed significantly over the years, at present ceramic composite material (Sic) used as protective coating of element of aircraft gas turbine combustion chamber, hypersonic technology products, where the acute problems of protection structure at high temperature in on oxidizing environment. Ceramic material combustion chamber coating (Sic) used to develop the small amount of thrust.

1.1 Principles of JET propulsion
The basic principle of the propulsion of aircrafts fairly simple. Newton's third law of motion, when broken down to its simplest form states, "to every action, there is equal and opposite reaction". What that means is, if you push on something that something will push back at you. In this same way propulsion formed, the 'body' is atmospheric air that is caused to accelerate as it passes through the engine. The force required to give this acceleration has an equal effect in the opposite direction acting on the apparatus producing the acceleration. A jet engine produces thrust in a similar way to the engine/propeller combination. Both propel the aircraft by thrusting a large weight of air backwards one in the form of a large air slipstream at comparatively low speed and the other in the form of a jet of gas at very high speed.

1.2 Combustion chamber
The combustion chamber (Figure 1) has the difficult task of burning large quantities of fuel, supplied through the fuel spray nozzles, with extensive volumes of air, supplied by the compressor and releasing the heat in such a manner that the air is expanded and accelerated to give a smooth stream of uniformly heated gas at all conditions required by the turbine. This task must be accomplished with the minimum loss in pressure and with the maximum heat release for the limited space available. The amount of fuel added to the air will depend upon

the temperature rise required. However, the maximum temperature is limited to within the range of 850 to 1700°C. by the materials from which the turbine blades and nozzles are made. The air has already been heated to between 200 and 550°C. by the work done during compression, giving a temperature rise requirement of 650

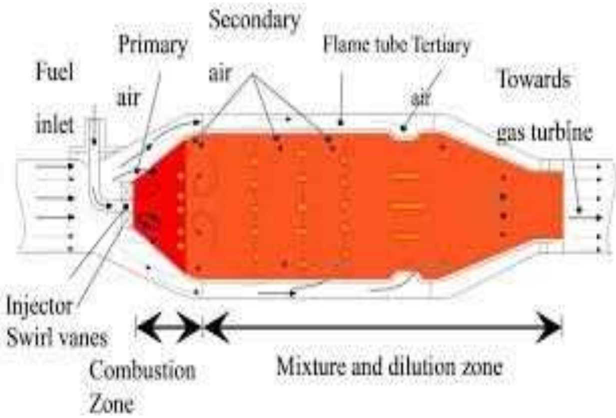

Figure 1: Combustion Chamber

To 1200 °C. From the combustion process. Since the gas temperature required at the turbine varies with engine thrust, and in the case of the turbo-propeller engine upon the power required, the combustion chamber must also be capable of maintaining stable and efficient combustion over a wide range of engine operating conditions. Efficient combustion has become increasingly important because of the rapid rise in commercial aircraft traffic and the consequent increase in atmospheric pollution, which is seen by the general public as exhaust smoke.

2. COMBUSTION PROCESS

Air from the engine compressor enters the combustion chamber at a velocity up to 500 feet per second, but because at this velocity the air speed is far too high for combustion, the first thing that the chamber must do is to diffuse it, i.e. decelerate it and raise its static pressure. Since the speed of burning kerosene at normal mixture ratios is only a few feet per second, any fuel lit even in the diffused air stream, which now has a velocity of about 80 feet per second, would be blown away. A region of low axial velocity has therefore to be created in the chamber, so that the flame will remain alight throughout the of a combustion chamber can vary between 45:1 and130:1, However, kerosene will only burn efficiently at, or close to, a ratio of 15:1, so the fuel must be burned with only part of the air entering the chamber, in what is called a primary combustion zone. This is achieved by means of a flame tube (combustion liner) that has various devices for metering the airflow distribution along the chamber. Approximately 20 per cent of the air mass flow is taken in by the snout or entry section. Immediately downstream of the snout are swirl vanes and a perforated flare, through which air passes into the primary combustion zone. The swirling air induces a flow upstream of the centre of the flame tube and promotes the desired recirculation. The air not picked up by the snout flows into the annular Space between the flame tube and the air casing.

2.1 Types of flow

They are many types are of gas flow in gas turbine

- Axial flow
- Radial flow
- Turbulent flow

Axial Flow

The fluid is pushed in a direction parallel to the shaft of the impeller, that is, fluid particles, in course of their flow through the pump; do not change their radial locations. It allows the fluid to enter the impeller axially and discharge the fluid nearly axially. The propeller of an AFP is driven by a motor.

Radial Flow

A radial turbine is a turbine in which the flow of the working fluid is radial to the shaft. The difference between axial and radial turbines consists in the way the fluid flows through the components (compressor and turbine).

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Turbulent Flow

Turbulent flow, type of fluid (gas or liquid) flow in which the fluid undergoes irregular fluctuations, or mixing, in contrast to laminar flow, in which the fluid moves in smooth paths or layers. In turbulent flow the speed of

the fluid at a point is continuously undergoing changes in both magnitude and direction. The flow of wind and rivers is generally turbulent in this sense, even if the currents are gentle. The air or water swirls and eddies while its overall bulk moves along a specific direction.

3. MODELING PROCESS

Ceramic coating combustion chamber is an advanced modeling apart from the combustion chamber. The chamber is designed according to the same principle of combustion. We look the studies of this combustion chamber and compared that ceramic coating combustion chamber is the best and designed it in CATIA software. The full design of Electromagnetic plasma arc propulsion system is shown in Figure 2.

Table 1 : Specifications

TABLE NO.1 :- SPECIFICATION		
S.NO.	PARTS	Dimension in (mm)
1	Combustion Chamber entering diameter	160
2	Width	490
3	Outer diameter	290
4	Primary and Secondary Zones Holes	15

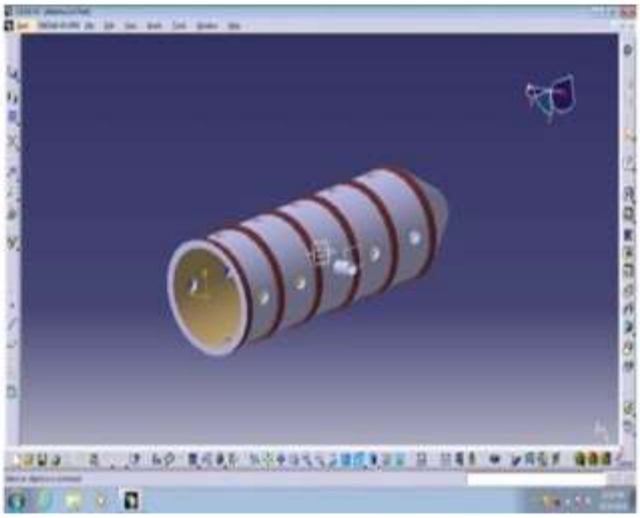

Figure 2: Ceramic Coating Combustion Chamber

3.1 Analysis process

Ceramic coating combustion chamber flows are practically done through flow analysis techniques. This process can be done through flow analysis in ANSYS software. It is the best analysis software for the Ceramic coating combustion chamber because the accuracy of the flow as shown the maximum percentage. All the difficult processes are done through, because in our analysis we are convert flow velocity into temperature load.

3.2 Meshing

The entire structure over the combustion chamber was meshed with Triangular mesh with an interval of 0.03. Triangular meshing was chosen because it was finer over the difficult regions when compared to the hexagonal mesh and it is shown in Figure 3.

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TABLE NO. 2 :- BOUNDARY CONDITIONS		
S.NO.	CONDITIONS	VALUE
1	Mass flow rate of air (kg/s)	7
2	Chamber inlet temperature (*c)	1200

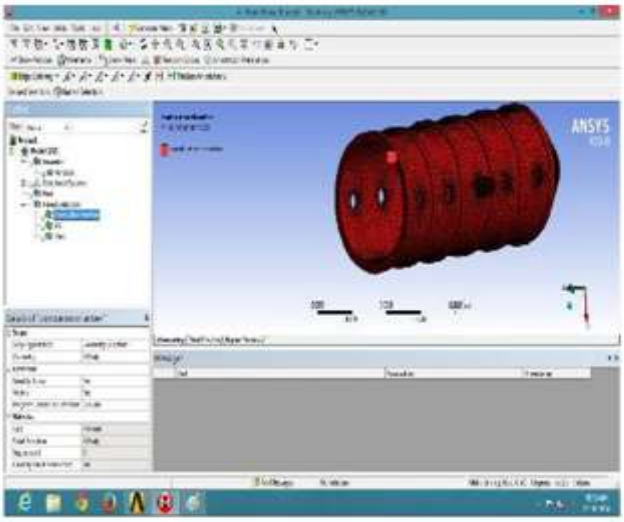

Figure 3: Grid Structure of Ceramic Coating Combustion Chamber

The temperature contour of the ceramic coating combustion chamber as shown in figure 4. This system analysis done by ANSYS software. Here the red colour indicates high temperature value and blue colour indicate low temperature value. We can identify from figure the temperature value is less in inlet section when compared to the exit chamber. Because principle of Combustion, the inlet section (or) chamber inlet have less temperature and exit section (or) chamber exit have more temperature. Here in this analysis we are used ceramic coating in inside surface of chamber and this coating thermal conductivity is less when compared to conventional once, so here heat transfer rate is low and the combustion efficiency is automatically increased. So the temperature is low in inlet section than exit section and the temperature is more in exit section than inlet section.

4. RESULTS AND DISCUSSION

We are calculated chamber parameters for ceramic coating combustion chamber. Also Compare chamber parameter with conventional chamber and that is listed below.

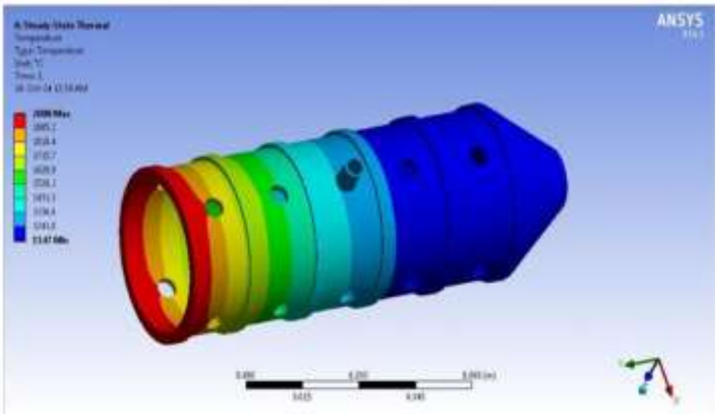

Figure 4 :-Analysis Process

Table 3 : Comparison Of Combustion Chamber

Ceramic Coating Combustion Chamber		Conventional Chamber (Thermal barrier coating based chamber)	
Performance	Value	Performance	Value
Thermal effieciency (%)	48.5	Thermal effieciency (%)	42.5
Heat Rate	0.033	Heat Rate	0.038
Specific Fuel Consumption	0.002	Specific Fuel Consumption	0.0023
Combustion Efficiency (%)	80	Combustion Efficiency (%)	70

We are plotted thrust graph for ceramic coating combustion chamber and conventional combustion chamber and also the graph shown below. The graph indicates the ceramic coating combustion chamber produce combustion efficiency in linearly, after combustion efficiency suddenly increases. The conventional combustion chamber Produce thrust linearly, but produce

rate of combustion efficiency is low than ceramic coating combustion chamber as shown in Graph 4. We are plotted combustion chamber parameters graph for ceramic coating combustion chamber and conventional combustion chamber and also the graph shown below. Identified from graph ceramic coating combustion chamber parameters are produce linearly, after parameters are suddenly increases. The conventional combustion chamber parameters are produce linearly, but produce rate of parameters are low than ceramic coating combustion chamber as shown in Graphs 1, 2, 3, and 4

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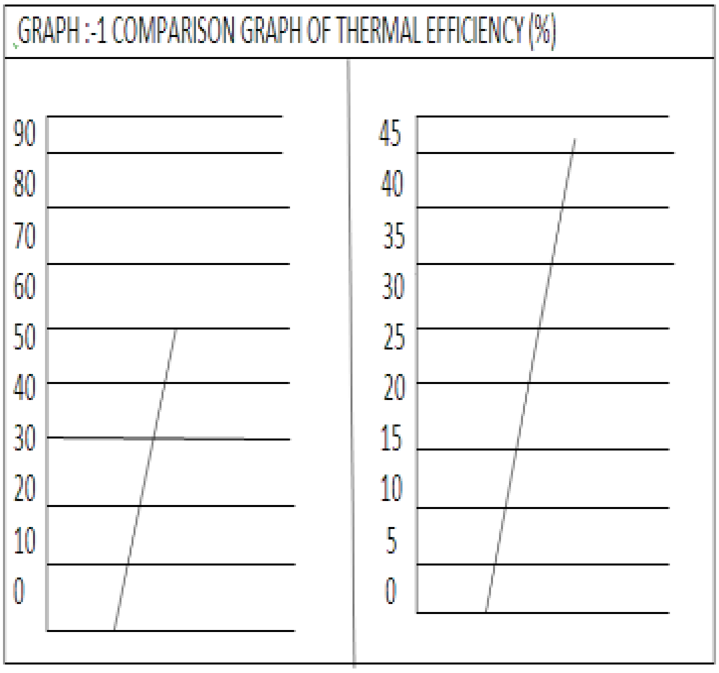

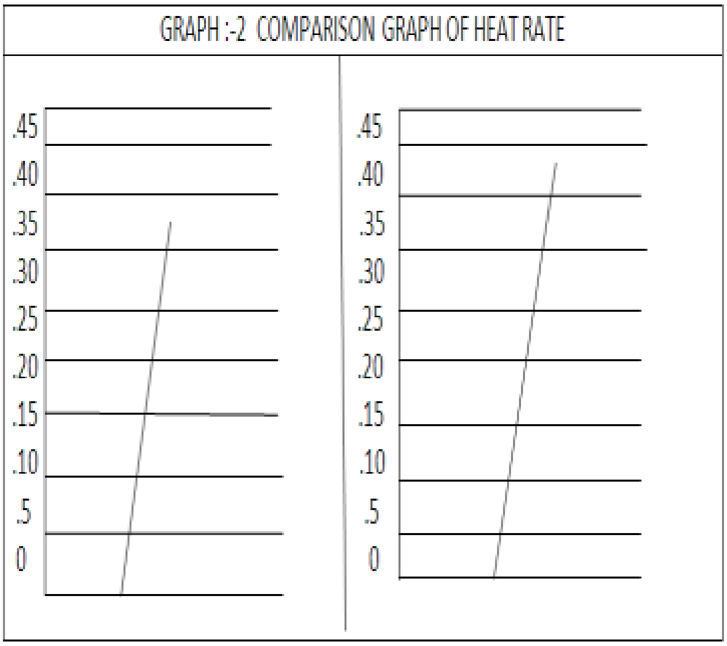

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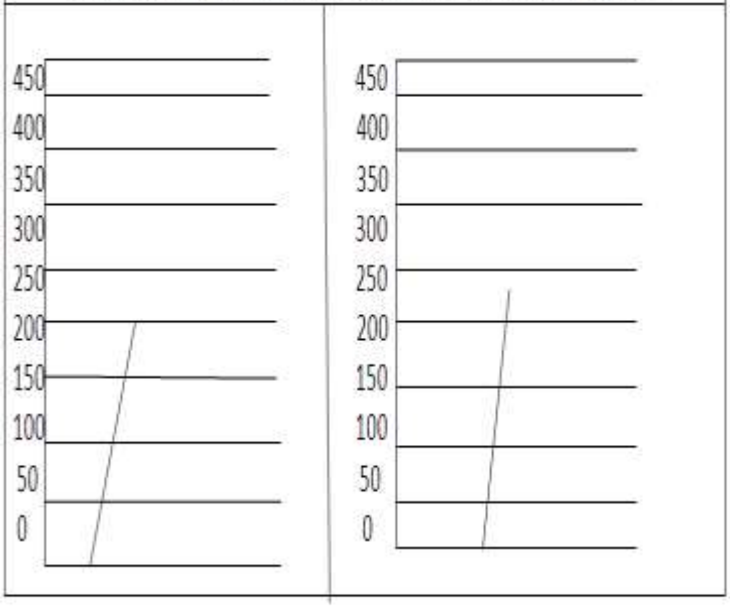
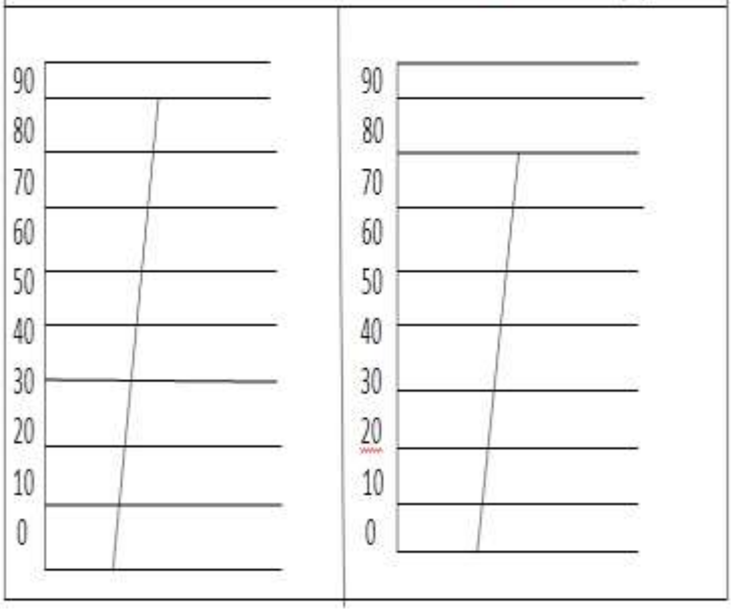
GRAPH :-3 COMPARISON GRAPH OF SPECIFIC FUEL CONSUMPTION(S^-1)



GRAPH :-4 COMPARISON GRAPH OF COMBUSTION EFFIENCY (%)



5. CONCLUSION

The Ceramic material coated combustion chamber, Aircraft Industries and Laboratories because it will give more combustion efficiency. Here ceramic coated combustion Chamber produced the more thrust at the same time combustion chamber life increased. If this combustion chamber was implemented small amount of thrust increased then compare to conventional combustion chamber. The ceramic material cost is less. This combustion chamber of conventional model may use in Laboratories and especially large aircrafts. Because of this system produce more combustion efficiency and life. If we are implement this system in future for Large efficiency, we can develop our country Gas turbine combustion chamber Research field when compared to other countries combustion chamber Research field and also we can face and overcome the combustion chamber efficiency Problems during combustion.

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