CHAPTER-3
AIMS OF THE PRESENT WORK

3.0 Objectives of Research:

The objectives are to use Lanthanum rare earth oxides and praseodymium rare earth oxides doped/stabilized zirconia (Lanthanum and praseodymium Zirconate) thermal barrier coatings and study their effect on diesel engine performance after coating its combustion chamber components. In order to achieve desired objectives,

The following procedure has been followed to achieve the above stated objectives.

(1) It is necessary to (There is need) develop more reliable and efficient thermal barrier coatings (TBCs). Current thermal barrier coatings are Zirconia based and are stabilized by Yttrium oxide. But other naturally available rare earth oxides can equally act as stabilizer in place of Yttrium oxide and bring about phase stability to Zirconia.

(2). Instead of using Yttrium oxide as stabilizer for Zirconia, the following rare earth oxides (called dopents) viz. For the present research work used a Lanthanum oxide, Praseodymium oxide, will replace in place of Yttria and be the new stabilizers. Add them individually exact composition to Zirconia and characterized (examine) the required quantity of dopant necessary to obtain partial or full stabilization of Zirconia through proper calcinations (sintering) process as shown in figure-3.(a)

(3) There are several methods of TBC powder preparation and most widely adopted method is sol-gel and wet ball mill method

i. Initially develop various La$_2$Zr$_2$O$_7$ and Pr$_2$Zr$_2$O$_7$ TBC powder with suitable composition using by agate and wet ball milling method.

ii. Figure.3b. shows the plasma sprayable Powders are synthesized by high energy 4-jar wet ball milling method and study the various surface structural characteristics of La$_2$Zr$_2$O$_7$ and Pr$_2$Zr$_2$O$_7$ TBC powders by identifying its exact surface crystallographic phases (by XRD), get chemical composition (by EDAX), and surface structure by SEM, and other structural properties such as densities, densification, % shrinkages, % porosities. And finally identify the powder flow ability, powder particle size & distribution, tap density, ect.
Once the synthesized a new zirconate thermal barrier coating powder to obtained the required properties, the powder is now ready/available for coating. Zirconate TBC (Top and Bottom coating) Coating have been done by choosing HVOF/Atmospheric plasma spray technique and study the thermo-mechanical and thermal barrier characteristics, adhesion strength, micro hardness, crystal structures (phases), microstructure and chemical composition. Before and after thermal shocks test on zirconate top coated on engine combustion chamber component material substrate to achieve the satisfactory results of the tests, and finally identified best compositions of Zirconate thermal barrier coating for internal surface of the combustion chamber components of a diesel engine and to study its performance on both Zirconate thermal barrier coated and un-coated standard single cylinder 4-stroke air cooled diesel engine.

![Figure 3.3(a) Schematic Flow Chart showing the main steps of Zirconate powder preparation by Wet ball mill method.](image1)

![Figure 3.3(b) Schematic Flow Chart showing the main steps of Zirconate powder plasma spray coated on substrates and engine components to finding the engine performance.](image2)