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Study and Effect of Exhaust Gas Recirculation (EGR) on the Performance and Emission Characteristics of Compression Ignition Engine.

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ABSTARCT:

When used in a diesel large scale engine as power sources applications medium and heavy range, due to lower fuel consumption and lower emissions of carbon monoxide (CO) and unburned hydrocarbons (HC), compared with engines gasoline. The efficient use of natural resources is one of the basic conditions for any country to be self-sufficient. Both in the formal and informal sectors of the internal combustion engine has become the main driver is indispensable. With the increasing demand for fossil fuels, the strongest threat to clean up the environment and posed as linked to burning fossil fuel emissions such as CO2, CO, sulfur oxides, nitrogen oxides and particulates which it is currently the main source of global emissions. In diesel engines, and the formation of nitrogen oxides is a very temperature dependent phenomenon. Therefore, in order to reduce emissions of nitrogen oxides in exhaust gases, it is necessary to maintain peak combustion temperature under control. of exhaust gas recirculation is the most important to reduce emissions of NOx method. recycling portion of the exhaust gas helps in reducing nitrogen oxides, but the emission of particles observed in a high concrete loads, and therefore there is a tradeoff between NOx and smoke. For most of this trade-off of interest, and can be used to trap particles to reduce the amount of unburned particles equitable geographical representation, and this in turn reduces particulate emissions as well. The pilot conducted an investigation to control the effect of exhaust gas recirculation exhaust gas temperature and exhaust opacity. The development of this experimental system proposed experiments in a single cylinder, direct injection, air-cooled engine compression ignition. Matrix has conducted

experiments to observe the effect of different amounts of equitable geographical representation in the degrees of the temperature of the exhaust gas and opacity

INTRODUCTION: Oxygen, nitrogen, helium, argon and what are the important industrial gases. Nature has provided us with a lot of these gases in the atmosphere and under the earth's crust. Available oxygen and nitrogen from the atmosphere, helium and argon and other available in the earth's crust. The main objective is to use these gases and used for the purpose it is important. Production and use of these gases constitute a significant part of the economy. One can say that this is a sign of technological improvement. These gases have different uses. Oxygen is used to produce steel, rocket propulsion and medical applications. Argon is used in TIG welding and high temperature furnaces. Helium find use in superconductivity, the use of nuclear reactors, etc. hydrogen as fuel in rocket propulsion systems. Nitrogen is a key input in the fertilizer industry. It is also used in the freezer and the semiconductor industry. Nitrogen is used as a blanket of gas in most chemical processes, and as a basic raw material for the production of fertilizers, chemicals, ammonia-based. High purity nitrogen is used as carrier gas in the electronics industry. The liquid nitrogen provides the most effective for many low temperature processes - and the cooling medium is desirable to reduce freezing.

This is the first important trapped from different sources and the use of low temperature process known as air separation to be separated from each other gases. This is done by using expansion of outside air separation turbines. air separation using turbo expanders has several benefits to the high pressure process (Lindy). These benefits include the cost of capital is low, mix and better products and high operational flexibility. While the operations environment, based on absorption and separation membrane, and find greater application, especially for low purity, and cryogenic distillation predominant method for the production of industrial gases in bulk temperature follows. cryogenic distillation process, which operates at a temperature below 100 K temperature, and offers many advantages over their peers room temperature. This process is economical in large scale, provides both liquid and gaseous products, argon and the production of noble gases (such as neon, krypton and xenon), and can respond to changes in demand in the product mixture.

In the petrochemical industry, it is used to separate turboexpander propane and heavier hydrocarbons from the natural gas stream. Extenders Turbo generates the necessary degree of recovery of ethane low temperatures and do so at a lower cost.

It is also used to extend applications turbine energy recovery and cooling and gas pressure head upper well, power cycles using geothermal heat, energy recovery pressure let down cycle organic Rankine used in the cooling process stations in order to achieve the total consumption of public services and document and other energy recovery from waste gas industries. expansion turbines can continuously for years and more reliable than other forms of piston expanders used extensively before. This is possible through the use of gas lubricated bearings, which are used as lubricant process gas. While most engineering machinery axial flow is used, and the cryogenic turbine adopts world mixed flow, axial radial inlet and discharge configuration. Multiple difficult to achieve from a radial flow or mixed geometry. Therefore, cryogenic turbines and expansion always depend on a stage, independently of the expansion rate. Besides its role in the production of liquid cryogen and provide a turbo expander refrigeration in a variety of other applications, both cryogenic and normal temperature. And use of a closed cycle coolers cold Brayton cycle based on reverse cooling devices detect radiation and superconducting magnets.

LITERATURE REVIEW:

Introducing the concept that the turbine can be used as a cooling device for the first time by Lord Rayleigh. In a speech of June 26, 1898 to nature, and the use of turbines is suggested rather than the process of liquefying air expansion piston due to the difficulties encountered in machines reciprocating temperature is low. In this letter, Riley most important cryogenic expander, which is the production of cold, instead of electricity function was confirmed. Occurred after a series of patents in the expansion turbine cooled principles. In 1898 a simple system of liquefaction Edgar C Thrupp British patent engineer using expansion turbines. Thrupp expands to twice the current of the machine to enter the center is divided into two streams that flow otherwise. Each end of the rotor consists of seven units in each of two to four rows parallel to the rotor axis blades. The air flow from the center to the outside through the moving blades of each disk and blades fixed interference in the turbine housing. This was in the form of the inner housing to bring the vacuum proximity of each rotor drive shaft back to disk a successor additional expansion.

In conjunction with Thrupp, American engineer Joseph E Johnson patented gas liquefying device. Some of the air to be liquefied was to condense in the nozzle of the turbine and the fall of the bottom of the liquefaction chamber for collecting and escaped gas turbine exhaust. It was patented refrigerative turbine expansion with the transverse flow within American Charles F and Oren J Crommett in 1914. The pattern was the gas that can enter the turbine wheel through a pair of holes, but is determined that requires no installation of the nozzle can be used. turbine blades has given me to do slightly concave faces with respect to the plane of the nozzle. This was a relatively short blades, no more than a very short distance from the rotor shaft.In 1922, he was American engineer and professor Harvey N Davis patented turbine thermal expansion of the concept of unusual. The purpose of these turbines has several nozzle blocks each receive a gas stream from the level of a different temperature than the high pressure side of the main liquefying heat exchanger device. Davis said that if the supply pressure sufficiently high throughout

It will be extended currents in the area in two phases and, despite achieving different degrees of humidity, it will reach the same final temperature.Not made a successful commercial application for the expansion of the turbine to liquefy the gas until early 1930. This has been done in the works of Linde in Germany. The axial flow turbine is used to machine a single step motivation. Later in 1936 was replaced by a radial flow turbine inside based on technology patented by the Italian inventor Guido Zerkowitz. The advantage of a single reverse room installed within the turbine wheel of the second to acceptance gas moving blades. In this way, you can achieve the speed of a vehicle with a consequent decrease in the speed of the wheel. specifications stipulated innocence can build turbines details to keep the pipes from the refrigerator and minimal losses. Shaft bearings to be totally out of the turbine housing is going on inside the cover of the machine and led out of the cold zone. Peter Kapitza, a Russian known in cryogenics in 1939 came out with a break through the paper. It contains two useful conclusions:

1. In this Kapitza compared thermodynamics Almcilon working in cycles high and low

pressure, and concluded that the low pressure liquefied better than high pressure gas.

2. Second, the Kapitza to show by analysis and the experimental results that the radial flow turbine inside the machine would be better central drive. After work Kapitza one of the first liquefaction of air turbine is well documented to be built, operated and was designed by the Elliott Company and built by the company Sharples has been done in 1942 and the machine as Swearingen described. The turbine and the type of radial flow reaction with a design speed of 22,000 rpm. He supported the turbine balls.

Work on the gas turbo expander containing small began in the early fifties Sixsmith at the University of Reading in a small air liquefaction plant. In 1958, it developed a radial turbine body UK Atomic Energy flow inside the plant for the production of nitrogen. expanders built-in fan load during the 1958-1961 Stratos section of Fairchild Aircraft Company turbo, especially to serve the air separation. Voth et al. Put the expansion turbines at high speed, as part of Musharraf cold refrigerator

Argonne National Laboratory (ANL). The first turbine was carried out using a commercial helium in 1964 in the refrigerator, which produces 73 watts at 3K for helium bubble chamber Rutherford. And put turbo alternator high-speed General Electric Company, New York in 1968 and has continued on a system containing a gas practice is able to work at the level of cryogenic temperature with low loss. National Bureau of Standards in Boulder, Colorado advanced turbine shaft diameter of 8 mm. Turbines operate at a speed of 600,000 rpm at inlet temperature 30 K degrees. In 1974, Sulzer Brothers, Switzerland put turbo expander for cryogenic gas stations with self-representation bearings. In 1981, of CRYOSTAR, Switzerland, which together with the development program manufacturer magnetic effect for the development of cryogenic turbo expander integrate active magnetic bearing both radial and axial direction. In 1984, test beta midsize model turbo expander and underwent a large-scale liquefied nitrogen. Izumi in Hitachi, Ltd., Japan developed a turbo expander small helium small refrigerator based on the Claude cycle. Turbo expander consists of a radial turbine inside the reaction flow and centrifugal fan brake on both sides of the bottom and top of the shaft supported by bearings self-acting gas. Qatar was the turbine wheel 6 mm 8 mm diameter shaft. The speed of rotation of the turbo expander

1st stage and 2nd 816 000 519 000 rpm, respectively.It has been customized and is not a pretty simple way to design high-performance expansion turbine through the universe. A study was initiated in 1979 to examine the plants in operation and generates factors related to the costs of the turbine set by the universe and Sentz. Sixsmith in collaboration with the Goddard Space Flight Center NASA NASA has developed a turbine mini-refrigerators cold Brighton cycle. This turbine has been developed, 1.5 mm diameter rotating at a speed of almost one million rpm. Yang has developed a two-stage expansion turbine mini made of 1.5 liters / hour of liquid helium cryogenic engineering laboratory of the Chinese Academy of Sciences. Turn turbines in more than 500,000 rpm. He took a small design, high-speed turbo expander by the National Bureau of Standards (NBS) United States of America. The first work in the expansion cycle of 600,000 in compressed gas bearings minutes externally. Turbo expander developed by Kate was a mechanism turbines with variable flow capacity (adjustable), which have the ability to control the cooling power of using a height variable nozzle vanes. It has developed wet helium turbo expander with the efficiency of a heat fixed rate of 70% expected by the Naka Fusion Research Institute Center Japan Atomic Energy Agency. Turboshaft expander consists of 40 mm 0.59 mm impeller and thrust bearings and self-acting gas. Inoue expansion put high proportion of radial flow turbine capacity for liquid helium of 100 L / h for use with superconducting generator 70 MW. Davydenkov new turbo expanders placed with foil helium cooled in Moscow, Russia bearing plants. The maximum rotation speed rpm 240 000 rotor with a shaft of 16 mm diameter. Turbo Expander was designed and manufactured the third phase in 1991, the system of gas expansion machine, for "Cryogenmash". It was every design stage turbo expander similar, are different from each other through the dimensions produced only by "Heliummash". gas lubricated bearings ACD feature film company hydrodynamics turbo expander TC-3000. Several refrigeration industries has been involved with this technology for many years, including the Mafi-Trench. Agahi said design process turbo expander to take advantage of modern technology, such as liquid bioinformatic software, numerical control technology computer and holographic techniques to further enhance the already impressive efficiency turbo-expander performance. Improvements have been made in technology and analytical techniques and carry design features turbo expanders are designed and operates in more convenient, as in rotation at a higher speed conditions. Sulzer Turbo is installed expander dry, wet Creare IHI turbo expander and centrifugal compressor cold and last for 8,000 hours at Fermi National Accelerator Laboratory, USA .. This accelerator department Section / cryogenics is responsible for maintenance and operation of each of the core liquid helium (Chile) and the cooling system of 24 satellites that provide cooling to 4.5 K synchrotron Tevatron magnets. Extenders thesis achieves 70% efficiency and good integration with the existing system. Sixsmith at Creare Inc., put the wet liquefied helium turbine small United States held in a particle accelerator at the Fermi National Laboratory. The He supported the expander shaft bearings and the rotor compressed gas was 4.76 mm at the cold end of the turbine and compressor 12.7mm brake at the end of the tibia. The rapid expansion of 384,000 cycles per minute design and design cooling capacity of 444 watts.Xiong Institute of Cryogenic Engineering, China put turbo expander cools the rotor of 103 mm long and weighs 0.9 N, working speed up to 230,000 rpm. Turbo expander have experimented with two types of gas lubricated bearings sheet magazine. Liquid Air Company L 'France has been the expansion cooled to manufacture turbine 30 years and over 350 turbo expanders that works around the world, installed in each of the industrial enterprises and research institutes. These turbines are characterized by the use of hydrostatic gas bearing, and provide reliability with mean time between failures measured only 45,000 hours. Atlas Copco turbo expanders manufactured with active magnetic bearings as an alternative to conventional bearing system oil for many applications. India has lagged behind the rest of the world in this area of research and development. However, progress has been significant over the past two decades. CMERI in Durgapur, placed radial turbine inlet depends on cryogenic plants Jadeja gas bearings. circulatory system gave stable at about 40,000 rpm. The program was, however, stopped before any tangible progress is achieved. Another program at IIT Kharagpur and developed a turbo expander unit thrust bearings using hot air and magazines was working speed of up to 80,000 rpm. Recently cooled Technology Division, it has developed a helium refrigerator reflection 1kW capable of producing at temperature 20K

METHODOLOGY:

CFD or computational fluid dynamics is predicting what will happen, quantitatively, when fluids flow, often with the complications of simultaneous flow of heat, mass transfer (eg perspiration, dissolution), phase change (eg melting, freezing, boiling), chemical reaction (eg combustion, rusting), mechanical movement (eg of pistons, fans, rudders), stresses in and displacement of immersed or surrounding solids. Computational fluid dynamics (CFD) is one of the branches of fluid mechanics that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows. Computers are used to perform the millions of calculations required to simulate the interaction of fluids and gases with the complex surfaces used in engineering. Even with simplified equations and high-speed supercomputers, only approximate solutions can be achieved in many cases. Ongoing research, however, may yield software that improves the accuracy and speed of complex simulation scenarios such as transonic or turbulent flows. Initial validation of such software is often performed using a wind tunnel with the final validation coming in flight test. The most fundamental consideration in CFD is how one treats a continuous fluid in a discretized fashion on a computer. One method is to discretize the spatial domain into small cells to form a volume mesh or grid, and then apply a suitable algorithm to solve the equations of motion (Euler equations for inviscid and Navier-Stokes equations for viscous flow). In addition, such a mesh can be either irregular (for instance consisting of triangles in 2D, or pyramidal solids in 3D) or regular; the distinguishing characteristic of the former is that each cell must be stored separately in memory. Where shocks or discontinuities are present, high resolution schemes such as Total Variation Diminishing (TVD), Flux Corrected Transport (FCT), Essentially Non Oscillatory (ENO), or MUSCL schemes are needed to avoid spurious oscillations (Gibbs phenomenon) in the solution. If one chooses not to proceed with a mesh-based method, a number of alternatives exist, notably Smoothed particle hydrodynamics (SPH), a Lagrangian method of solving fluid problems, Spectral methods, a technique where the equations are projected onto basis functions like the spherical harmonics and Chebyshev polynomials, Lattice Boltzmann methods (LBM), which simulate an equivalent mesoscopic system on a Cartesian grid, instead of solving the macroscopic system (or the real microscopic physics). It is possible to directly solve the Navier-Stokes equations for laminar flows and for turbulent flows when all of the relevant length scales can be resolved by the grid (a direct numerical simulation). In general however, the range of length scales appropriate to the problem is larger than even today's massively parallel computers can model. In these cases, turbulent flow simulations require the introduction of a turbulence model. Large eddy simulations (LES) and the Reynolds-averaged Navier-Stokes equations (RANS) formulation, with the k-ε model or the Reynolds stress model, are two techniques for dealing with these scales. In many instances, other equations are solved simultaneously with the Navier-Stokes equations. These other equations can include those describing species concentration (mass transfer), chemical reactions, heat transfer, etc. More advanced codes allow the simulation of more complex cases involving multi-phase flows (e.g. liquid/gas, solid/gas, liquid/solid), non-Newtonian fluids (such as blood), or chemically reacting flows (such as combustion).

4.2 DISCRETIZATION METHODS IN CFD

The stability of the chosen discretization is generally established numerically rather than analytically as with simple linear problems. Special care must also be taken to ensure that the discretization handles discontinuous solutions gracefully. The Euler equations and Navier-Stokes equations both admit shocks, and contact surfaces.

Some of the discretization methods being used are:

- Finite volume method (FVM). This is the "classical" or standard approach used most often in commercial software and research codes. The governing equations are solved on discrete control volumes. FVM recasts the PDE's (Partial Differential Equations) of the N-S equation in the conservative form and then discretize this equation. This guarantees the conservation of fluxes through a particular control volume. Though the overall solution will be conservative in nature there is no guarantee that it is the actual solution. Moreover this method is sensitive to distorted elements which can prevent convergence if such elements are in critical flow regions. This integration approach yields a method that is inherently conservative (i.e. quantities such as density remain physically meaningful

- Finite element method (FEM). This method is popular for structural analysis of solids, but is also applicable to fluids. The FEM formulation requires, however, special care to ensure a conservative solution. The FEM formulation has been adapted for use with the Navier-Stokes equations. Although in FEM conservation has to be taken care of, it is much more stable than the FVM approach. Subsequently it is the new direction in which CFD is moving. Generally stability/robustness of the solution is better in FEM though for some cases it might take more memory than FVM methods.
- Finite difference method. This method has historical importance and is simple to program. It is currently only used in few specialized codes. Modern finite difference codes make use of an embedded boundary for handling complex geometries making these codes highly efficient and accurate. Other ways to handle geometries are using overlapping-grids, where the solution is interpolated across each grid.
- Boundary element method. The boundary occupied by the fluid is divided into surface mesh.
- High-resolution schemes are used where shocks or discontinuities are present. To capture sharp changes in the solution requires the use of second or higher order numerical schemes that do not introduce spurious oscillations. This usually necessitates the application of flux limiters to ensure that the solution is total variation diminishing.

CONCLUSIONS

Cryogenic turbine has great utility in industrial collection of gases. They also provide a wonderful medium for refrigeration. The modeling of the various parts of the turbine is done using Gambit and the computational fluid dynamics analysis is done using fluent software. The velocity contours and graphs indicating the variation of temperature, pressure and velocity along the meridonalstreamlength is given. However the results are not accurate as the leakage are not taken into consideration. Moreover the original material used to construct the turbine is also not taken into consideration.

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