Experimental Investigation of Four Stroke SI Engine using Oxyrich Air Energizer for Improving its Performance

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Abstract*- Over the past century, need and development of micro-power devices have necessitated the need for studies to look further into mediums that can enhance combustion processes of fuels by optimizing system parameters. This is essential so as to utilize the high specific energy content of liquid hydrocarbon fuels. As we know that main source of pollution is oxides nitrogen (NOx) so method or apparatus is develop which is used as pre-processing unit for the automobile mainly. This method and apparatus for reducing the emissions and improving the performance of an internal combustion engine. An input air stream is separated into an oxygen-enriched air stream and a nitrogen-enriched air stream. The nitrogen-enriched air stream is received by a holding chamber. The oxygen-enriched air and a combustible fuel are provided to a combustion chamber of the internal combustion engine and a combustion process is initiated. After a predefined time delay, a volume of nitrogen-enriched air is provided from the holding chamber to the combustion chamber to be used during the rest of the combustion process or we can also used separated nitrogen for other useful application such as air-conditioning or cooling purpose.*

Keywords:- Air-energizer, Oxyrich, SI engine

I. INTRODUCTION

Hydrocarbons have basically a “cage like” structure. That is why oxidizing of their inner carbon atoms are hindered during the combustion process. Furthermore they bind into larger groups of pseudo-compounds. Such groups form clusters (associations). The access of oxygen in the right quantity to the interior of the groups of molecules is hindered (it has nothing to do with incoming air from the manifold in the fuel mixture, when even though there may be the excess of it this will not provide the required hydrocarbon-oxygen binding) and stemming from this shortage of oxygen to the cluster that hinders the full combustion. In order to combust fuel, proper quantity of oxygen from air is necessary for it to oxidize the combustible agents. For many years designers of the internal combustion engines have had one goal - to oppose the effect of molecular association of the hydrocarbon fuel and to optimize the combustion process. The problem in designing engines for air pollution is that in order to fully burn all the hydrocarbons in the combustion chamber, operating temperatures of the cylinders have had to be increased. While older engines may have produced relatively large quantities of unburned hydrocarbons and carbon monoxide, they produced low quantities of oxides of nitrogen. Also, with the renewed interest in performance engines, compression ratios are creeping upward again and once again the mechanism for producing higher levels of nitrogen toxins is increased. Similarly, turbo charging effectively alters the compression ratio of a vehicle further adding to the nitrogen. But even then fuels that leave the "afterburners" are not ideally clean - engine still burns only part of the fuel. The rest is discharged as polluting emissions (HC, CO, NO_x) or is deposited on the internal engine walls as black carbon residue. The incomplete combustion process has caused all this. The application of focused magnetic field converts fuel molecules to a positive charge and sets them in order, which increases the attraction of negatively charged air molecules, boosted by the hared air to compensate for the improper fuel/air mixture of the non-efficient sensor., which is placed in automotive vehicles on the air duct before the air filter to allow for the optimum combustion and further reduction of toxic substances. This significantly improves the process of oxidation. As a result the corrosion and scale deposits are dissolved and the new ones do not form in the whole cooling system, engine gets back 100% of its heat transfer ability and can be exploited longer. They are installed on the rubber line, preferably on fuel line as close to the engine as possible. The primary factors used in determining the efficiency of a combustion process are: 1) excess oxygen; 2) carbon monoxide; and 3) stack temperature as an indicator of heat available for use. These three parameters combine in complex manner to determine the efficiency. Drop in oxygen percent in stack indicates lowered oxygen emission that is a direct indicator of higher burning efficiency. On natural gas as well as other gasses, there is usually no carbon monoxide given off by the combustion process. This additional oxygen requirement is the exact behavior sought for the increased combustion efficiency and fuel savings. Proper re-airing must be achieved to restore the proper oxygen reading to its pre installation reading. In reality, efficiency increase may be much higher, whenever this system is placed on gaseous hydrocarbon fuels such as propane, gasoline etc., the air/ fuel mixture becomes fuel "rich", the Fuel/ Air ratio must be adjusted. In most cases, increasing the air feed will bring the combustion efficiency into proper stoichiometric balance. The unit increases gas mileage and performance and can easily be transferred from car to car, with almost no labor. The units have low cost as compare to the catalytic converter system and are totally friendly to the environment. Compared to savings during the exploitation of the vehicle and extending engine's life, this is a really small investment. Technological and economical advantages, as well as engine performance gradually increase (as the number of driven miles/kms increases), reaching the highest effect at the end of the test. If we can bind up all the available oxygen with the hydrocarbon fuel, there simply will be no oxygen left over to form the unwanted nitrogen compounds. It appears that magnetic treatment is the simplest means of achieving this. The fuel treatment has shown decreases in unburned hydrocarbon and CO reductions. Stoichiometrically, there is very little oxygen left to produce any additional toxic compounds with nitrogen.

Para magnetism is a result of unpaired electrons within an atom that can cause a magnetic dipole to form in the presence of a magnetic field and, as a result, in the presence of a magnetic field this effect causes the fluid to be drawn in the direction of increasing magnetic field strength. On the contrary, if the electrons are already paired, the atoms resist the formation of a dipole and this resistance causes the atoms to move in the direction of decreasing magnetic field strength, known as diamagnetism. Paramagnetic behavior is about three orders of magnitude larger than the diamagnetic behavior. Oxygen and air are examples of paramagnetic substance and are drawn towards higher magnetic field strengths. Nitrogen, carbon dioxide and most hydro carbon fuels are examples of diamagnetic substances and are repelled by stronger magnetic fields.

Thus, the behavior of these gases in the magnetic field suggests a new scientific method of analysis and separation in gases, using the magnetic field. Traditional methods have always focused on use of additives to achieve the means which leads to a recurring cost and poor impact on the life of the combustion systems in the long runs. Today Hydrocarbon fuels have a natural deposit of carbon residue that clogs carburetors and fuel injectors, leading to reduced efficiency and wasted fuel. Knocking, stalling, loss of horsepower and greatly decreased mileage are very noticeable. This results from incomplete combustion of hydrocarbon fuel. In order to promote complete combustion of hydrocarbon fuels, oxygen must saturate the fuel molecules. Hydrocarbon fuels posses large clustering molecules that tend to bunch up into groups, preventing complete oxygen penetration. For this reason 100 percent combustion does not take place.

The apparatus of the present invention can best be described as a means for the intensified exposure of an oxyrich air. The apparatus is comprised the oxygen cylinder. The outlet of oxygen cylinder sends to suction of engine. The oxygen sends to the engine suction trough the flow measuring devices like rotameter, orificemeter. The gas rotameter is used to measure the flow rate of oxygen.

II. LITERATURE REVIEW

Various researches would be done on I.C. engine for improving its performance. Following are the some researches related to the intake side of the S.I. engines. Most of vehicles are running on S.I. engine, therefore it is essential to develop a best performance S.I.engine.

Maxwell et al.(1) had investigated utilization of oxygen-enriched air in diesel engines holds potential for low exhaust smoke and particulate emissions. This paper deals with the fundamental considerations associated with the oxygen-enriched air –fuel combustion process to enhance understanding of the concept. The increase in adiabatic flame temperature, the composition of exhaust gases at equilibrium, and also the changes in thermodynamic and transport properties due to oxygen-enrichment of standard intake air are computed. The effect of oxygen-enrichment on fuel evaporation rate, ignition delay, and premixed burnt fraction are also evaluated.

Anderson et. al. (2) had investigated position change of the waste gate influences the residual gas masks and cause the volumetric efficiency to change, which produces a transient in the air mass flow to the cylinder.

C. Wu et. al. (3) had discussed the analysis of a supercharged Otto engine adopted for Miller cycle operation. The Miller cycle shows no efficiency advantage and suffers a penalty in power output in the normally aspirated version. In the supercharged Otto engine adopted for Miller cycle version, it has no efficiency advantage but does provide increased net work output with reduced propensity to engine knock problem. Sensitivity analysis of cycle efficiency versus early close of intake valve and that of cycle net work versus early close of intake valve are performed. Optimization on the cycle efficiency is obtained.

S.V.Saravanan. et. al. (4) Investigation of pollution monitoring and its control for the Indian petrol light duty vehicles applications to meet emission regulations". International Journal of Enviro-media vol.4 pp.821-826 2006. The experiment is note worthy in that hydrocarbon fuels do not exhibit a dipole moment. It is to be understood that the hydrocarbon based fuel should not have responded as it did to the presence of the magnetic field. However, Faraday's investigations showed that all substances are magnetic, although in most cases the magnetic effect is very small. In the case of hydrocarbon based fuel, which was formerly thought to be a polar substance without a magnetic moment, the van der Waals experiment proved that electrons in all substances can be affected by an external magnetic field. Increased combustion yields increased fuel efficiency with lower hydrocarbon emissions from hydrocarbon based fuel burning apparatus. The focus the magnetic field in opposition or directional alignment, determine magnetic field strength, select appropriate magnetic materials and determine mounting arrangements for the greatest efficiency. Earlier attempts have proven to be less than satisfactory, producing only limited results as can be seen from the discussion of the teachings of the several patents.

Govindasamy et. al. (5) had discussed the object of the present invention to increase the fuel burning efficiency of a Hydrocarbon fuel passed through a conduit or containment vessel about which the apparatus is mounted in diametrically opposed positions to create a uniform magnetic flux density to affect the molecules of the fluid fuel in such a manner as to increase the fuel burning efficiency.

Shehata et al. (6) Had concluded the use of EGR in spark ignition engine is promising method for improving part load operation conditions. Catalyst converter installed in exhaust manifold provides significant reduction in UHC and CO concentrations on contrast exhaust temperature increases after catalyst than before catalyst due to some of heat release with oxidation of UHC and CO species into CO_2 and H_2O. Air injection in exhaust manifold is the simplest method for reducing UHC and CO concentrations due to increase oxygen concentration after exhaust valve opening. Sound pressures level (SPL) increases with the increase of engine speed and load.

Said et al. (7) had observed air enhancement devices for air intake manifold systems of automotive engines have been widely available in the market with the claim that they can improve fuel-air mixing and thus bring more power to the engine performance and better fuel efficiency. However, there is lack of evidence to complement the claim. The objective of this study is to investigate the ability of an air enhancement device in improving the performance of a spark ignition (SI) engine. The investigation is performed by an experiment on a four stroke single cylinder engine test bed, in which the air enhancement device is installed at the downstream of the air intake manifold. The result shown that the brake power, brake mean effective pressure and torque increase significantly with the engine speed when operated at 30% to 50% of the open throttle positions. However, no distinct difference in the results is observed when the engine is running at higher throttle openings.

Killingsworth et al.(8) have investigate the role of both the compression ratio and the specific heat ratio on engine efficiency by conducting experiments comparing operation of a single-cylinder variable-compression-ratio engine with both hydrogen-air and hydrogen-oxygen-argon mixtures. For low load operation it is found that the hydrogen-oxygen-argon mixtures result in higher indicated thermal efficiencies. Peak efficiency for the hydrogen-oxygen-argon mixtures is found at compression ratio 5.5 whereas for the hydrogen-air mixture with an equivalence ratio of 0.24 the peak efficiency is found at compression ratio 13. For most operating points Air concentration of 86% by volume results in the highest efficiency, then 88% Air has the next highest efficiency and 84% Air typically results in the lowest efficiency. For all three blends of Air with O2, the peak efficiency occurs at compression ratio 5.5. The overall highest net indicated thermal efficiency achieved is 44.8% for an Air concentration of 86% at compression ratio 5.5.

Kirwan et al. (9) had investigated turbocharged Gasoline Direct Injection (GDi) engines are a key enabler for downsizing that can substantially reduce CO_2 emissions from gasoline engines. Good low end torque is critical to maintain good drivability with downsizing and down speeding in turbocharged engines. Low end torque increases with GDi because it allows improved scavenging efficiency and cools the intake charge to reduce knock. GDi also improves fuel control and mixture motion to improve combustion efficiency.

Dahnz et.al. (10) had discussed the possible reasons for pre-ignition were identified systematically and assessed by taking into account the results of experimental and numerical investigations. Thus pre-ignition could be ascribed to the presence of lubricant oil droplets released from the top land in the combustion chamber. In this context, wall wetting owing to the lateral injector position was found to be crucial. However, the comparison of these results with those obtained in studies using different engines reveals that the assessment of mechanisms seems to be not universally valid. Hence, auto-ignition processes were described on a very general level but at the same time a bridge was built to the actual combustion phenomena. Reasons for the occurrence of auto-ignition were discussed as well as its effect and measures for its avoidance.

Hargude et. al. (11) had observed rising fuel costs are bearing on the economy of the country, at the same time rising pollution level are playing havoc with the health of the multitudes. Present study involved with these interactions, is the intensity of the suction air that could effectively alter the combustion characteristics. The aim is to study if such air can alter combustion behavior. The end result is a more efficient & complete combustion, saving fuel up to 15% consistently. The main aim of increasing the output from 10-25% in SI engines, reduces hot spotting inefficiency, cutting out missing and stalling, and reduction in low-octane pinging and stabilizes vapor problems is considerably achieved.

III. AIR ENERGIZER

An AIR ENERGIZER is nothing but a simple pair of magnets which is used to magnetize the incoming air. It is installed on intake manifold pipe as well as air intake pipe. After installation of magnets on pipes it creates magnetic field which magnetizes the paramagnetic oxygen in air. This helps to improve combustion in engine.

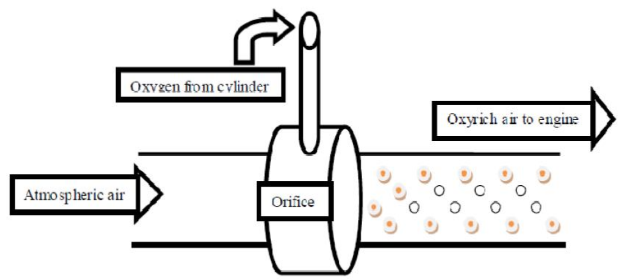
AIR ENERGIZER is an apparatus which ensures complete combustion in an IC Engine. It improves combustion efficiency and gives extra mileage and power of I.C. Engine. It ensures minimum deposition of carbon on the spark plug and on the engine piston head improves compression capacity of the piston helping in the reduction in noise and vibration.

THE OXYRICH TREATMENT OF INTAKE AIR:

The oxyrich treatment of intake air represents a new technology. Many attempts by various inventors and scientific investigators worldwide have been far less than satisfactory due to the implementation of what has become known as the blending technique [6]. This is of supreme importance, since it is required to have the necessary power (quantity) to properly excite the electron activity causing the increased oxidation effect. The recent advent of the gas emission analyzer, which is used to enforce state and federally regulated emission standards in accordance with the science of stoichiometry, has greatly aided in the documentation of oxyrich air research results.

When the unit under investigation is attached to the suction line of an engine, we see an immediate drop in unburned hydrocarbons and carbon monoxide. This is due to the oxygen conditioning of the air, which makes it more reactive. The purpose of a catalytic converter on automobiles is to oxidize (burn) carbon monoxide into carbon dioxide. As related in stoichiometric charts representing ideal combustion parameters, the highest burning efficiency will be achieved at the highest carbon dioxide level, since carbon dioxide cannot be subsequently oxidized [8]. The purpose of a catalytic converter is to reduce all carbon monoxide to carbon dioxide. The increased combustion efficiency is occurring within the engine due to increased fuel reactivity with oxygen (increased xidation), the main factor responsible for increased combustion efficiency. It is a complete waste to allow an engine to run inefficiently and to burn the excess carbon monoxide in its catalytic converter, the wasted heat merely "heats-up" the exhaust system, instead of providing useful work within the engine. Overall generation of carbon dioxide will drop due to better overall engine efficiency.

IV. WORKING PRINCIPAL



A) When hydrocarbon fuel (methane molecule) is combusted, the first to be oxidized are the hydrogen atoms. Only then, are the carbon atoms subsequently burned (CH_4+ $2O_2$ = CO_2+ $2H_2O$). Since it takes less time to oxidize hydrogen atoms in a high-speed internal combustion process, in normal conditions some of the carbon will be only partially oxidized; this is responsible for the incomplete combustion. The optimum combustion efficiency (performance) obtained from the oxygen enricher application on air is first indicated by the amount of increase in carbon dioxide (CO_2) produced, which has been validated by state emissions control devices.

B) Altering the spin properties of the outer shell ("valence") electron enhances the eactivity of the fuel. The higher energized spin state of hydrogen molecule clearly shows a high electrical potential (reactivity), which attracts additional oxygen. Combustion engineering teaches that additional oxygenation increases combustion efficiency; therefore, by altering the spin properties of the H_2 molecule, we can give rise to its magnetic moment and enhance the reactivity of the hydrocarbon fuel and ameliorate the related combustion process. The unit to have the required affect on fluid passing through it, substantially changes the isomeric form of the hydrocarbon atom from its Para hydrogen state to the higher energized, more volatile, ortho state, thus attracting additional oxygen.

C) It has been technically possible to enhance Vander Waals' discovery due to the application of the oxygen energizer, strong enough to break down, i.e. de-cluster these HC associations. They become normalized & independent, distanced from each other, having bigger surface available for binding with more oxygen (better oxidation). A simple analogy is of burning coal dust and a coal brick. There, where one aims at higher efficiency, during the combustion process, one has to give a molecule the greater access to oxygen. Thus, with our oxygen energizer, the oxygenation and the combustion efficiency increase. Fuel is more active and dynamic, and the combustion process faster and more complete.

D) The chief function and purpose of a oxyrich air is to convert engine burnt hydrocarbons and reduce by oxidizing (burning), all carbon monoxide (CO) to carbon dioxide (CO_2) and water (vapor). An energizer neutralizes exhaust, which has left the combustion chamber of an engine. Such exhaust is less toxic, but the energy from such an after-burning process is not utilized. While catalytic converters are designed to function beyond 5 years and 50,000 miles (80,000 kms), there are problems that can occur (trace amounts of oil escaping to the exhaust, etc.) dramatically shorten their life (destroy them).

Oxygenated fuel burning:

Hydrogen, even though it is the simplest of all elements, occurs in two distinct isomeric varieties (forms) para and ortho, characterized by the different opposite nucleus spins para H2 molecule, which occupies the even rotation levels (quantum number), the spin state of one atom relative to another is in the opposite direction counterclockwise", "anti parallel", "one up & one down") rendering it diamagnetic, whereas in the odd rotational levels, the spins are parallel ("clockwise", "coincident", "both up"), with the same orientation for the two atoms, and therefore is paramagnetic and a catalyst for many reactions. Thus the spin orientation has a pronounced effect on physical properties (specific heat, vapor pressure), as well as behavior of the gas molecule. The coincident spins render ortho exceedingly unstable.

In fact, ortho-hydrogen is more reactive than it has hydrogen fuel that is used to give power for the combustion processes. To secure conversion of para to ortho state, it is necessary to change the energy of interaction between the spin the H2 molecule. The aim is to stu to better understand the combustion interaction; a laminar flow would be established and subjected to a moderate uniform combustion process. Specifically, the study entails the collection of experimental data for the influence on the structure and temperature variations together with the influence on the particle formation.

V. DEVELOPMENT OF SYSTEM

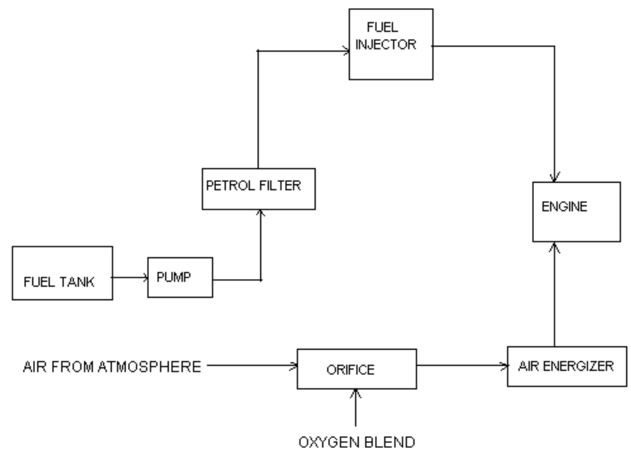
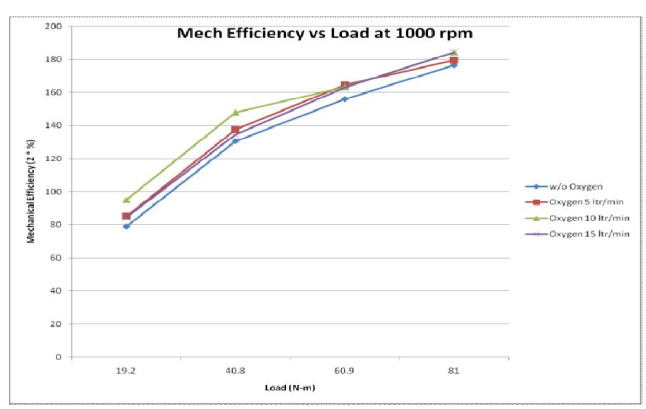
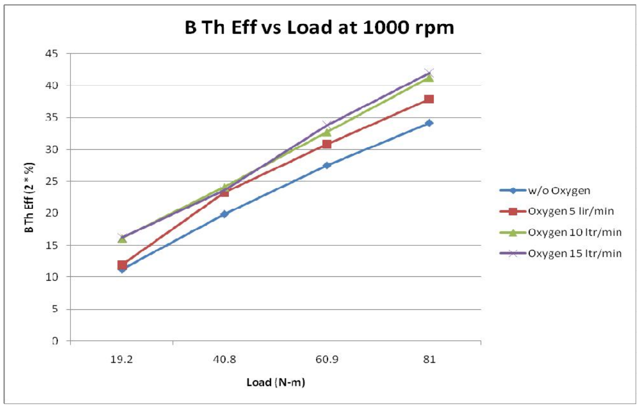


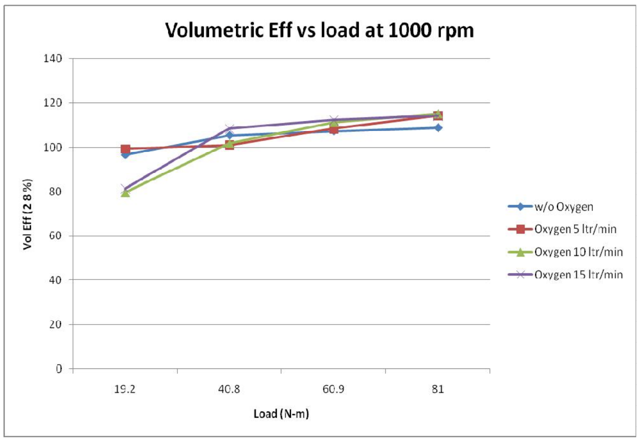
Fig.: Layout of Experimental Set-up

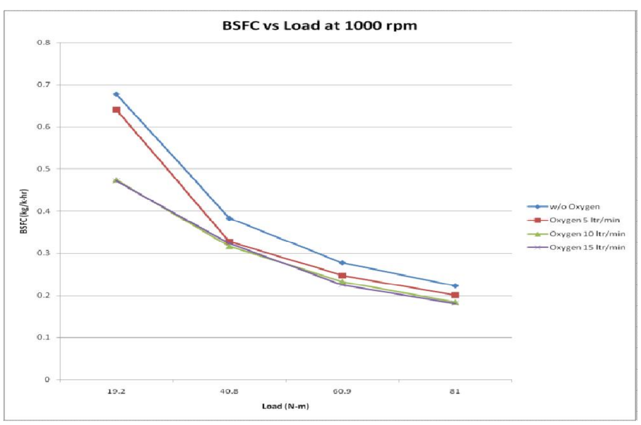
Above fig. shows the proposed schematic diagram of the project, where the one side of the engine is fuel line & other side is air line. Air from the atmospheric come into orifice & the pure oxygen is injected into that air in orifice. The effect of oxygen blend is to increase the amount of oxygen in air. After that the magnets are placed over the air line for magnetizing the air. The segment and circular type permanent magnet is used for magnetizing the air. Simultaneously all the performance parameters are to measured by using computerized test rig of 4 stroke petrol engine and pollution of system will be measured by using exhaust gas analyzer and compared it with and without oxyrich air energizer.

VI. RESULT GRAPHS AND CONCLUSION









Above graphs shows show that oxyrich engines are performing better than without oxyrich. Graphs also demonstrate that correct amount of oxygen helps for complete combustion and more power output. Even more oxygen is not contributing for further increasing performance. Only required amount of oxygen supply needs to be provided.
Moreover it decreases pollution also.

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