Design of a Machine for Lapping & Cleaning of Engine Valves

Prof. Sneha Pawade#1, AkashHajnale*2, Vishal Karade#3,Krishna Gambare#4, Gaurav Gandhile#5

#*Mechanical Department, SavitribaiPhule Pune University*

Abstract— **Automobile maintenance is a major area in the industry of automobile and also a major income to the business. Present, engine maintenance can be stated as a very important section in automobile maintenance and the valve lapping process that is subjected in this thesis is done during engine maintenance. Methods used in most automobile maintenance for valve lapping process are not effective and consume a lot of working hours. 'Valve lapping Machine is a machine designed to overcome these problems by minimizing the human involvement in process. It consist of the background in designing the machine, results obtained by data analysis in order to optimize the design and design of the valve lapping machine. Lapping is a machining process in which two surfaces are rubbed together, by hand movement or using a machine. This can take two forms.The first type of lapping involves rubbing a brittle material such as glass against a surface such as iron with an abrasive such as aluminium oxide, jeweller's rouge, optician's rouge, emery, etc., between them. This produces microscopic conchoidal fractures as the abrasive rolls about between the two surfaces and removes material .The other form of lapping involves a softer material such as pitch or a ceramic for the lap. The softer material, which holds it and permits it to score across and cut the material. Taken to a limit, this will produce a surface such as with a polishing cloth on an automobile, or a polishing cloth .Taken to the ultimate limit, with the aid of accurate interferometer and specialized polishing, lens makers can produce surfaces that are flat to better than 30 nanometers. Surfaces flat can be molecularly bonded by bringing them together under the conditions.**

Keywords— **Lapping, Valve, Knock, Cylinder Head, IC Engine.**

I. INTRODUCTION

Valve lapping or the process of creating a good seat between engine valves and the corresponding valve seat area in the IC engine head is a task which have to be done very accurately. The importance of obtaining a good sea is that the air/fuel mixture or airis prevented from flowing in to the combustion chamber, same as the exhaust gas is prevented from flowing to the exhaust manifold from the combustion chamber until the right time. And also a good seat prevents compression leaks. The engine will lose its efficiency by huge percentages if any of the situations explained above happens.

Fig.1 A sample line graph using colours which contrast well both on screen and on a black-and-white hardcopy

So as this is a very important task in IC engine maintenance, extra attention is given to this particular task by technicians. This process of valve lapping is typically done using a lapping stick. These process can be replaced by the ' Valve Lapping Machine for Internal Combustion Engines', specifically designed for the process of engine valve lapping. It is fully mechanical system which performs two different motions in two directions previously performed by hand when using valve lapping stick. The valve lapping machine is very effective because the human involvement is limited in the process. A valve job is an operation which is performed on internal combustion engine, the purpose of which is to resurface the mating surfaces of the poppet valves and their respective valve seats that control the intake In the earliest automotive engines, the valves needed to be removed and the sealing surfaces sanded, ground or lapped multiple times during. As the decades passed, however, engines ran cleaner and the addition of tetraethyl lead in gasoline meant that such maintenance became more frequent. Today, valve jobs are done on passenger cars for the purpose of maintenance, although they are still quite common with high-performance cars. Some reasons that may induce the need for a valve job in a modern passenger include: excessive RPM, high mileage, overheating, material failure, and foreign object damage (FOD).

II. OBJECTIVE

The main goal of this project is to design a machine efficient and effective than previously used methods for process and to reduce the labour cost by reducing the human involvement in the work .The objectives that had to be achieved in order to achieve the main goal were designing the basic model of the machine designing the valve lapping mechanism, assembly of the machine by designing the parts needed, designing the cam, analysing data and categorizing them in order to design holding pieces, analysing data to obtain the specifications of the machine, obtaining two high torque dc motors that has specific RPM values and deciding what materials must be used in order for the design to be durable and economical.

III. PROBLEM DEFINITION

The main purpose of the project is to minimize the human effort with excellent machines with precision although the time required for the process is the same for manual as well as the machine but, if we use a machine instead of the person the person can do another job by this time. Also the efforts which are given by employee will be reduced.

IV. SCOPE

1.The objective of this work is to develop a New Automatic operated Machine of Value Lapping.
2.This concept allows us to achieve our goal as well as better space management.
3.The new model takes into account all the real time conveying system and provides solution over their short coming.
4.The New model will get good efficiency compare to old method

V. LITERATURE REVIEW

Effect of EGR on the exhaust gas temperature and exhaust opacity in compression ignition engines

In diesel engines, NOx formation is a highly temperature-dependent phenomenon and takes place when the temperature in the combustion chamber exceeds 2000 K. Therefore, in order to reduce NOx emissions in the exhaust, it is necessary to keep peak combustion temperatures under control. One simple way of reducing the NOx emission of a diesel engine is by late injection of fuel into the combustion chamber. This technique is effective but increases fuel consumption by 10–15%, which necessitates the use of more effective NOx reduction techniques like exhaust gas recirculation (EGR). Re-circulating part of the exhaust gas helps in reducing NOx, but appreciable particulate emissions are observed at high loads, hence there is a trade-off between NOx and smoke emission. To get maximum benefit from this trade-off, a particulate trap may be used to reduce the amount of unburnt particulates in EGR, which in turn reduce the particulate emission also. An experimental investigation was conducted to observe the effect of exhaust gas re-circulation on the exhaust gas temperatures and exhaust opacity. The experimental setup for the proposed experiments was developed on a two-cylinder, direct injection, air-cooled, compression ignition engine. A matrix of experiments was conducted for observing the effect of different quantities of EGR on exhaust gas smoke opacity has been developed. Experiments were carried out using the setup to prove the efficacy of EGR as a technique for NOx reduction. It is seen that the exhaust gas temperatures reduce drastically by employing EGR. This indirectly shows the potential for reduction of NOx emission. This can be concluded from the fact that the most important reason for the formation of NOx in the combustion chamber is the high temperature of about 2000K at the site of combustion. Thermal efficiency and brake specific fuel consumption are not affected significantly by EGR. However particulate matter emission in the exhaust increases, as evident from smoke opacity observations. Diesel engines score higher than that of other engines in most aspects like fuel consumption and low CO emissions, but loses in NOx emissions. EGR is proved to be one of the most efficient methods of NOx reduction in diesel engines. The increase in particulate matter emissions due to EGR can be taken care by employing particulate traps and adequate regeneration techniques. Our sincere thanks to the staff of the Energy Conversion Laboratory, Department of Mechanical Engineering for their cooperation and assistance in setting up the experimental set-up and their help in performing experimental investigation.

Injector Fouling and Its Impact on Engine Emissions and Spray Characteristics in Gasoline Direct Injection Engines

In Gasoline Direct Injection engines, direct exposure of the injector to the flame can cause combustion products to accumulate on the nozzle, which can result in increased particulate emissions. This research observes the impact of injector fouling on particulate emissions and the associated injector spray pattern and shows how both can be reversed by utilising fuel detergency. For this purpose multi-hole injectors were deliberately fouled in a four-cylinder test engine with two different base fuels. During a four hour injector fouling cycle particulate numbers (PN) increased by up to two orders of magnitude. The drift could be reversed by switching to a fuel blend that contained a detergent additive. In addition, it was possible to completely avoid any PN increase, when the detergent containing fuel was used from the beginning of the test. Microscopy showed that increased injector fouling coincided with increased particulate emissions. Based on these results a selection of the injectors was installed in a laboratory injection chamber and the spray patterns were investigated with a high speed camera. Injectors corresponding to the largest PN drift produced the thinnest spray jets with the deepest penetration. These factors amplify the risk of wall wetting and provide an explanation for the increase of PN. The positive effect of the detergent was also reflected in the spray pattern analysis, which illustrates the potential benefits of such fuel additives. Due to the fuel delivery design of direct injection gasoline engines, injectors are exposed to the harsh environment of the combustion chamber, which can lead to deposit formation on the injector tip. The resultant alteration of the fuel spray can increase engine emissions, particularly PN and PM.In order to study this effect and the potential of fuel detergency to reduce it, a set of injectors were deliberately fouled in an engine test cycle. The injectors were then cleaned with a detergent containing fuel in a similar engine cycle. During the first cycle an increase of particulate numbers of more than two orders of magnitude was observed. Fuels with detergent additives did not produce any significant increase in particulate emissions during this phase. When the engines operating with fouled injectors were run with detergent containing fuel, particulate emission reverted back to their original levels in most cases. Analysis of the injectors via microscopy confirmed that the fouling on the surface and nozzles of the injector tips correlated with an increase of PN/PM emissions during the engine test. Operating the engine with detergent containing fuel cleaned the injectors and resulted in decreased particulate emissions.Analysis of the spray patterns in a laboratory injection chamber backed-up the trends observed. Fouled injectors produced sprays with smaller cone angles and deeper penetration depths compared to clean injectors, which can promote wall wetting and lead to particulate emissions through rich fuel combustion. These results highlight a representative selection of the spray data available, which allows comparison with the PMPN emission from the engine tests. Future work will focus on expanding the results with a systematic and numerical analysis of the spray images

Petrol Engine Exhaust Valve Design,Analysis And Manufacturing Processes

The aim of this paper is to design an exhaust valve for a four wheeler petrol engine using theoretical calculations. Manufacturing process that is 2D drawings is drafted from the calculations and 3D model and transient thermal analysis is to be done on the exhaust valve when valve is open and closed. Analysis is done in ANSYS. Analysis will be conduct when the study state condition is attained. Study state condition is attained at 5000 cycles at the time of when valve is closed is 127.651 sec valve is opened 127.659 sec.The material used for exhaust valve is

EN52 steel. We are doing material optimization bydoing analysis on both materials EN52 and EN59.Static Modal analysis the exhaust valve to determine mode shapes of the valve for number In-direct benefit: This becomes a Poke- Yoke to avoid reverse material forging which is one of the critical customer complaints.

Combustion Analysis and Knock Detection in Single Cylinder DI-Diesel Engine Using Vibration Signature Analysis

The purpose of this paper is to detect the “knock” in Diesel engines which deteriorate the engine performance adversely. The methodology introduced in the present work suggests a newly developed approach towards analysing the vibration analysis of diesel engines. The method is based on fundamental relationship between the engine vibration pattern and the relative characteristics of the combustion process in each or different cylinders. Knock in diesel engine is detected by measuring the vibration generated by the engine using The DC-11 FFT analyser with accelerometer. Knock in diesel engine is mainly due to the engine miss .A diesel engine miss results from one or more cylinders when the fuel is not burning properly. Improper fuel burning is caused by Injection system problems which include, Faulty injectors, clogged fuel filters, incorrect Injection timing, Low engine compression, injection system leaks, Air leaks, faulty injection pump etc. Engine miss causes rapid combustion with very high pressures generating a rumble or dull clattering sound. Abnormally loud sound with violent vibration is called “knocking or detonation”. Engine cylinder vibration in FFT form is monitored at each load the cylinder excitation frequencies are compared with the base line frequencies using diesel oil. Time wave forms on the cylinder head are also recorded to analyze the combustion. Since the very combustion in the cylinder is the basic exciter, the vibration study of the engine cylinder through the measured FFT and time waveforms are the representatives of combustion propensity. Vibration accelerometer is mounted on the cylinder head, preferably on the bolt connecting the head and the cylinder to record the engine vibrations using DC-11 data logger which directly gives the spectral data in the form of FFT, the overall vibration levels. This FFT data recorded is collected by On-Time window based software designed by e-predict Inc., Argentina. The Time waveforms are obtained on the cylinder head by DC-11 in the OFF-ROUT.The vibration studies indicate that there is tradeoff between the vibrations Recorded in different directions on the cylinder head. There is also a tradeoff between the cylinder head vibration and the engine foundation vibration. Since the spectrum recorded on the cylinder head is the representative of the combustion inside the cylinder,it can be assessed that new mode of combustion has taken place with different excitation frequencies.In the crucial frequency range of 900Hz to 1300 Hz, the amplitude rise is abnormal to the tune of 0.45 g at full load run of the engine. This can be acclaimed to better torque conversion at this percentage.The time waves indicate longer time duration of combustion during firing stroke in the case of injection of water Knock is detected with water injection at 1/4 Full Load. Knock tendency decreases with increase of load with water injection.With Palm Methyl ester operation the engine has not developed any Knock tendency this may be due to thehigher Cetane number of Palm Methyl ester.At Part loads the engine may develop knock tendency but at higher

Cylinder Head Intake Port Design & In-Cylinder Air-flow Patterns,Streamlines formations,Swirl Generation Analysisto Evaluate Performance & Emissions

On the verge of rapidly increasing threat of global warming; the environmental emission norms are becoming stringent. In-cylinder flow characteristics at the time of injection and subsequent interactions with fuel sprays and combustion are fundamental considerations for the engine performance and exhaust emissions of a diesel engine. Intake ports are designed to provide the optimum balance between air flow and desired in-cylinder air motion characteristics which is governed by the swirl and tumble motion during the intake stroke. The effect of intake port design on swirl generations, flow patterns and streamlines has been analysed with CFD tool. The results of the CFD simulation will assist to improve understanding of the intake process of internal combustion engine and performance evaluation of intake ports and simulation resultscan be verified out by prototype testing on swirl testrig. In this paper, I have given more focus on developing intake port geometry to meet the swirl ratio required to meet emission and intake ports were simulated on CFD to know velocity vectors, different flow patterns and is used to predict/improve performance. CFD simulation of intake ports and prototype testing results compared to know the compatibility of CFD tool results. The arrangement and orientation of helical and directed port have an important effect on swirl ratio and intake flow interference and different swirl value can be optimized with different valve location andlayout on cylinder head further.

Material Removal Mechanisms in Lapping and Polishing

Polishing processes are critical to high value production processes such as IC manufacturing. The fundamental material removal mechanisms, however, are poorly understood. Technological outputs (e.g., surface finish, sub-surface damage, part shape) and throughput of lapping and polishing processes are affected by a large number of variables. Individual processes are well controlled within individual enterprises, yet there appears to be little ability to predict process performance a priori. As a first step toward improving process modelling, this paper reviews the fundamental mechanisms of material removal in lapping and polishing processes and identifies The physical scale of material removal processes in polishing is such that it is difficult (practically impossible) to observe them directly. Much of what we know about the fundamental mechanisms involved in the process has been derived either by correlating macroscopic measurements of process outputs with models, or by extrapolation from experiments at scales which can conveniently be observed. Process complexity and the murky nature of some of the scaling laws make such extrapolations risky. It is not surprising, therefore, that good predictive models of material removal in polishing processes are the exception rather than the rule. All, however, is not bleak. As we have shown, improvements in understanding of the basic interactions in polishing are providing models that correlate with some of the counterintuitive behaviours observed experimentally. None of the models seem to treat transitions well. The paper has also shown areas where substantial further work is required, for example in the (elasto)-hydrodynamics of CMP. Perhaps the least well understood aspect of the system is the lap, especially when that lap is faced with a pad.

Loading conditions appear to be key to understanding removal mechanisms. It is notable that the diamond Particle (granule) size Removal rate α β γ β' Particle (granule) size Removal rate α β γ β' [A+δA] P+δPP+δP [A+δA] [A+δA] Baseline polishing results of Samuels and others, where pads are used, show a relationship between granule size and removal rate more similar to CMP than to diamond lapping processes. As noted above, frictional heating and hydrodynamic effects modulate the loading conditions. The process maps introduced in Section 8 offer a means to conceptualize transitions between mechanisms and their effect on removal rates. The idea may be extended to other important dependent variables (for example surface finish) and other process inputs (fluid viscosity etc.).This paper has attempted to characterize polishing via the fundamental interactions between four critical elements of the process. Understanding these interactions seems critical to improving our ability fto relate changes in process input variables to productivity and part quality. Currently the bulk of such predictions require that many of the less well understood process variables be "held constant". Longer term, development of new processes will be accelerated by fundamental physical understanding of the entire system. Aksu and Doyle's recent papers describing insitu electro-chemical measurements during polishing provide insight into the formation of passivation films in copper CMP. They also provide a much needed (but perhaps unintentional) brake on our enthusiasm; as they point out, the optimum removal behaviour (at pH 12) provides poor selectivity for oxide layers. The "system examples" presented in this paper discuss only a single material removal system. Such models must be subsumed into a system model of all the technologically important features of an economically viable production process.

Taguchi Method for Investigating the Performance Parameters and Exergy of a Diesel Engine Using Four Types of Diesel Fuels

The effectiveness of Taguchi methodology is underlined by replacing the required (44 = 256) tests, needed to decide the effect of parameters: engine speed, throttle and water temperature for four types of fuel by only 16 deciding experiments as indicated The throttle has a proportional relation to break mean effective pressure as a result of the increase in the quantity of injected fuel. The best operating point was accomplished at 75% of full throttle.Throttle position has no effect on volumetric efficiency of test engine.Water temperature is second most effective parameter on engine operation for minimum BSFC. The optimum temperature for improved brake thermal and exergic efficiencies is found to be 80oC.As the water temperature was increased the volumetric efficiency dropped. During the experiments, the maximum volumetric efficiency was recorded at a water temperature of 65oC.The optimum engine speed for the test engine, based on maximum volumetric efficiency, minimum BSFC and improved values of thermal and exergic efficiencies was 2500 rpm. Fuel specific gravity has a limited effect on BSFC. It is shown from the results that the reduction in power caused by the reduction in volumetric flow rate is compensated by increasing the fuel density.

VI. WHAT IS VALVE LAPPING?

In the process of valve lapping in an internal combustion engine cylinder head, the goal is to achieve a good seat between valve seating area of an engine valve and the valve seat area of cylinder head in order to avoid the compression leaks through the seating from the combustion chamber and to avoid mixture leaking in to the combustion chamber through the seating. The internal combustion engine operates by achieving a certain compression ratio which is differing from engine and combusting a air-fuel mixture which is compressed to a certain volume decided by the compression ratio. And if the air-fuel leaks through the seating, the volume of the air- fuel will change and combustion process will not be accurate resulting a reduction in engine. It is vital to have a fully sealed combustion chamber and the valve seating is very important in acquiring a fully sealed chamber.

VII. CONCLUSION

The problem of holding engine valves was solved by designing valve holding pieces.
Valve lapping mechanism was implemented replacing manual labour.
Cylinder head supports has eased the moving of cylinder heads horizontally.
Valve lapping mechanism was designed as a assembly of several parts easing any maintenance to the machine.
All the designs could be completed successfully.

VIII. REFERENCES

[1]Levendis Y A, Pavalatos I, Abrams R F 1994 Control of diesel soot hydrocarbon and NOx emissions with a particular trap. SAE 940460

[2]Lundquist U, Smedler G, Stalhammar P 2000 A comparison between different EGR systems for HD diesel engines and their effects on performance, fuel consumption and emissions. SAE 2000-01-0226

[3]Mehta S, Oey F, Sumbung C L, Levendis Y A 1994 An aerodynamically regenerated diesel particulate trap with a flow-through soot incinerator section. SAE 940461

[4]Pierpont D A, Montgomery D T, Reitz R D 1995 Reducing particulate and NOx using multiple injections and EGR in a D. I. diesel. SAE 950217

[5]Sher E 1998 Motor vehicle emissions control: Past achievements, future prospects. Handbook of air pollution from IC engines pollutant formation and control (San Diego, CA: Academic Press) pg 9–10

[6]Stearns R F, Johnson R R, Jackson R M, Larson C A 1951 Derivation of flow equations. Flow measurements with orifice meters (Princeton, N J: D V N Com.) p-4

[7]Zelenka P, Aufinger H, ReczekW, CartellieriW1998 Cooled EGR–A technology for future efficient HD diesels. SAE 980190