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Interfacing Of Automation In Air Filter Cleaner

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Abstract

The air filters in an air intake system permanently removes foreign particles such as dust, dirt and soot from the intake air, thereby maintaining the performance of the engine and protecting it from damage. Proper maintenance can help vehicles perform as designed, thereby positively affecting fuel economy, emissions, and overall drivability. This paper addresses the issues of air filters proper cleaning. In contrast, a recent study showed that the fuel economy of modern gasoline vehicles is virtually unaffected by filter clogging due to the closed loop control and throttled operation of these engines. Because modern engines operate without throttling, a different result could be anticipated. This paper describes the measured results with focus on changes in vehicle fuel economy but also includes performance. The effects of air filters performance were studied and the analysis is carried out with the different diesel engine of cleaned air filters.

Key words:

1. INTRODUCTION

Air cleaners are used in a wide range of automotive applications. From passenger cars to heavy duty trucks, there is always an air cleaner to keep inlet air free of impurities and air flow passage obstruction in low levels. The air filters in an air intake system permanently remove foreign particles such as dust, dirt and soot from the intake air, thereby maintaining the performance of the engine and protecting it from damage. A clean air filter results in improved gas mileage, better acceleration, increased engine life, lower emissions and overall improved engine performance. Not only does an air filter clean the air entering the engine but it also prevents debris from entering the engine and causing damage. As an air filter becomes dirty, the capacity for it to filter the air going into the engine is reduced [1]. Because of this, the engine is not able to function properly, which may cause numerous drivability issues. Symptoms of a dirty air filter vary but often times include a noticeable decrease in gas mileage. A dirty air filter prevents the necessary volume of clean air from reaching the engine which affects the emission control systems of the car; reducing air flow and causing a too rich air-fuel mixture which can foul the spark plugs. Fouled spark plugs can create an engine miss, rough idle and even starting problems. In addition, a too rich fuel mixture increases engine deposits which may even cause the Service Engine Soon light to come on. Over the past decade, numerous emission standards and engineering achievements have come together to create advanced, clean, and flexible engines. These diesel engines and the vehicles they power are demanding for smaller air cleaner system package sizes, increased contaminant loading performance, improved contaminant separation efficiency, and higher temperature performance, all the while maintaining low initial restriction to airflow. Emissions compliant engines, extended oil drains and oils and tighter component tolerances all contribute to the need for increased air filtration system performance. Proper maintenance can help vehicles perform as designed, positively affecting fuel economy, emissions, and overall drivability. The issue of air filter proper cleaning improves fuel economy. The automobile air cleaner element is a part that needs to be replaced periodically, and making this part last longer is essential. Generally, to achieve longer life, it has been necessary to raise the space ratio of the material making up the filter element, but it is difficult to do this and maintain cleaning efficiency at the same time. For this particular reason, it

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has been necessary to select filter elements to suit the properties of impurities as well as the usage environment and to proper clean these elements or remove impurities on a frequent basis [2].

Pavan kumar goud & Chakradhara [3] addresses the issues of air filters replacement. older studies of carbureted gasoline vehicles have indicated that replacing a clogged or dirty air filter can improve vehicle fuel economy and, conversely, that a dirty air filter can be significantly detrimental to fuel economy. In contrast, a recent study showed that the fuel economy of modern gasoline vehicles is virtually unaffected by filter clogging due to the closed loop control and throttled operation of these engines. Because modern engines operate without throttling, a different result could be anticipated. Today there are 30 to 40 different filter applications around the automobile to be found. The technological performance requirements of the majority of these products are usually more straightforward and are often but vaguely defined. This paper describes the measured results with focus on changes in vehicle fuel economy but also includes emissions and performance. Previous studies shows that, replacing clogged air filter can improve vehicle fuel economy and conversely a clogged air filter can be significantly detrimental to fuel economy. The effects of air filters performance were studied and the analysis is carried out with different simulation results in the form of numerical simulation of flow particles captured by air filters.

Patel et al [4] investigated on engine lifetime, engine emission and fuel consumption depend on the air induction system design and its performance, So Study of papers on different type of air filter filtration media and their effect on engine performance is done in this paper. This study is useful to select zero maintenance, long life, reliable and durable air filters improves performance of the existing engines without any major modifications.

Maris Gailis & Vilnis Pirs [5] studied evaluates current periodicity of engine air filter replacement to determine the influence of this operation on some vehicle performance parameters. The experience of usage, costs of exploitation and technical condition of the vehicle are connected with a technically and economically based system of technical servicing. Periodicity of motor air filter replacement, declared by the automobile manufacturer Renault ranges from 30 000 km to 120 000 km, depending on the model and engine type. According to the same recommendations, periodicity must be reduced by a half, if conditions of use include dusty roads and exploitation of the vehicle in urban conditions. The aim of the research is to evaluate the criteria, according to which actual replacement of motor air filters was performed and to measure the influence of air filters with different levels of use on the engine performance. To reach the goal, air filter cartridges from 100 vehicles of the same model and type, which were used in Latvia were collected. The influence of air filter clogging on several vehicle exploitation parameters, such as engine power and fuel consumption was analyzed.

2. Experimental setup

Every four wheelers has air filter the function of air filter is used to filter the air which is being sucked by the engine during suction stroke. Now a day's air filter cleaning is very difficult in four wheelers because it has carbon net paper is very thin so, we need the skilled labour persons for this cleaning operation, if the filter is not clean proper it will hurt fuel economy performance & environment. We are going to fabricate new method for cleaning operation. For rotating the two non interesting shafts we are going to use the bevel gear mechanism. One the shaft is lead screw which will carry the nut upward and downward using the DPDT Switch condition. Where the another shaft will rotate the air filter, the copper tube is attached in the nut which will supply the two bar pressure compressed air to clean the air filter in proper way, here the filter is cleaned by automatic without the help of manual cleaning or replacement of the air filter. Now the air filter is cleaned in proper way by automatically and it's reused the filter with the increase in engine efficiency & performance.

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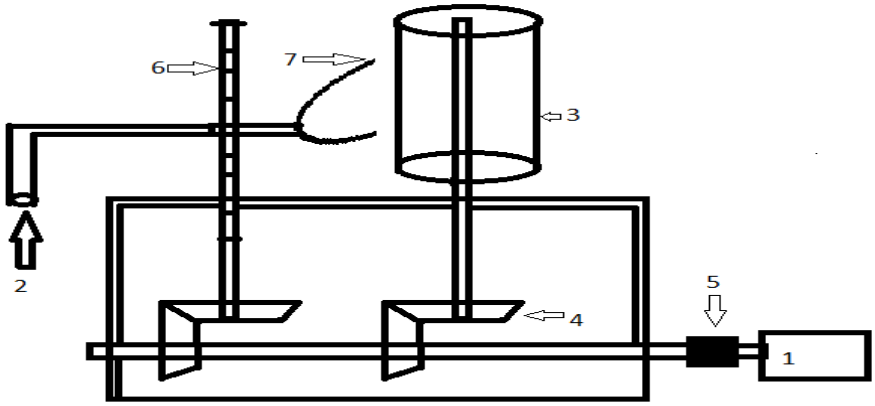

1. DC Motor, 2.Polyurethane tubes, 3.Airfilter, 4.Bevelgear, 5.Coupling, 6. Lead screw, 7.carbon tube.

Fig.1 Experimental setup for automation in air filter cleaner

3. Analysis and comparative studies

Design of diesel engine air intake systems requires the integration of many technologies and the balancing of many factors. At a given technology level, each property can be improved through compromises in another property. Size can be reduced by reducing filter efficiency, reducing filter life, or increasing filter pressure loss. Advancements in technology are required to achieve simultaneous improvement in multiple parameters. These technology advancements can take several forms, from simply improving via design and materials expertise. Therefore the engine testing was performed only with the specified air filters available in the market which were arranged and plugged for diesel engine and considered as constant speed @ 750 rpm with different load conditions to analyze performance. The results anticipated are

Table 1: Previous performance of bus air filter

S.NO	Load (KW)	B.P (KW)	F.P (KW)	I.P (KW)	T.F.C (Kg/hr)	S.F.C (Kg/KW.hr)	η_{MECH} (%)	$\eta_{B.P}$ (%)	$\eta_{I.P}$ (%)
1	0	0	1.65	1.65	0.36	0	0	0	37.55
2	2	0.237	1.65	1.897	0.4	1.649	13.02	5.06	38.87
3	4	0.488	1.65	2.139	0.45	0.922	22.82	8.89	38.94
4	5	0.603	1.65	2.253	0.47	0.779	26.76	10.50	39.25
5	6	0.836	1.65	2.486	0.51	0.61	33.62	13.44	39.36

Table 2: New performance of automation in bus air filter cleaner

S.NO	Load (KW)	B.P (KW)	F.P (KW)	I.P (KW)	T.F.C (Kg/hr)	S.F.C (Kg/KW.hr)	η_{MECH} (%)	$\eta_{B.P}$ (%)	$\eta_{I.P}$ (%)
1	0	0	1.85	1.85	0.48	0	0	0	38.55
2	2	0.50	1.85	2.23	0.59	1.89	14.05	6.26	40.87
3	4	0.58	1.85	2.58	0.61	1.05	23.36	9.89	39.94
4	5	0.73	1.85	2.78	0.64	0.85	28.02	12.10	40.25
5	6	0.93	1.85	2.96	0.7	0.65	34.5	13.90	41.56

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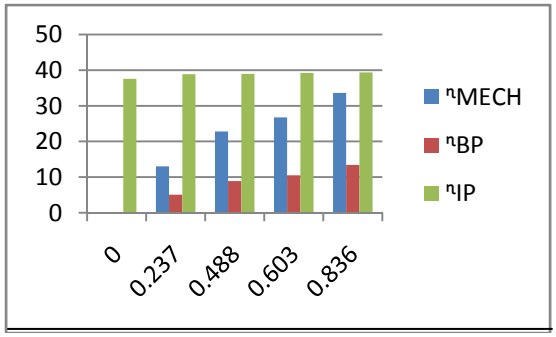
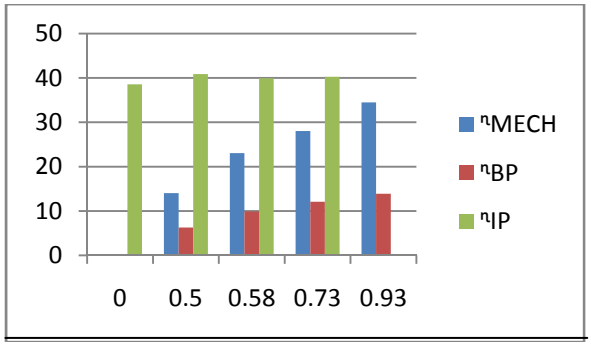


BP VS η_{MECH}, η_{BP}, η_{IP}

Fig. 2 previous performance of bus air filters



BP VS η_{MECH}, η_{BP}, η_{IP}

Fig. 3 New performance of automation in bus air filter cleaner

A study of clogged air filter results shows no significant effect on the fuel economy of the engine. The engine control systems were able to maintain the intake restrictions, and therefore fuel consumption was not increased. By considering the Tabel1 & Tabel2 study filter the initial change in Specific fuel consumption decreased in clogged type air filter as resulted in higher in efficiency of the engine, as with cleaned filter of same model with same specific fuel consumption. The efficiency of the engine validated and difference observed as 3.1% increase of efficiency. At constant speed of 750 rpm with different same load conditions in both filters the efficiency of break thermal is increased with 0.83 %, but as load increases after 4 kW the efficiency slightly decrease, this is due to observation of in sufficient air supply / proper fuel burning.

Table 3: Previous performance of truck air filter

S.NO	Load (KW)	IP (KW)	BP (KW)	TFC (KW)	S.F.C (Kg/KW.hr)	FP (KW)	η_{mech} (%)	η_{IP} (%)	η_{BP} (%)
1	0	0.162	0	0.822	0	10.03	0	1.45	0
2	2	0.179	0.018	0.981	57.70	11.97	9.48	1.497	0.142
3	4	0.213	0.051	1.014	19.88	12.37	23.84	1.729	0.412
4	5	0.265	0.103	1.382	13.42	16.86	38.35	1.572	0.647
5	6	0.396	0.234	2.028	8.67	24.74	58.95	1.604	0.946

Table 4: New performance of automation in truck air filter cleaner

S.NO	Load (KW)	IP (KW)	BP (KW)	T.F.C (Kg/hr	S.F.C (Kg/KW.hr)	FP (KW)	η_{Mech} (%)	η_{IP} (%)	η_{BP} (%)
1	0	0.183	0	0.721	1.07	11.05	0	1.56	0
2	2	0.193	0.018	0.695	0.498	12.52	10.2	1.84	0.162
3	4	0.247	0.062	0.801	0.374	13.45	25.54	1.94	0.536
4	5	0.283	0.109	0.986	0.324	17.24	40.52	1.67	0.864
5	6	0.426	0.247	1.064	0.431	25.24	60.2	1.83	1.03

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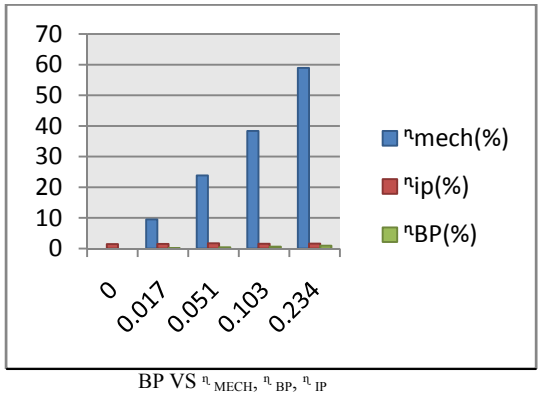
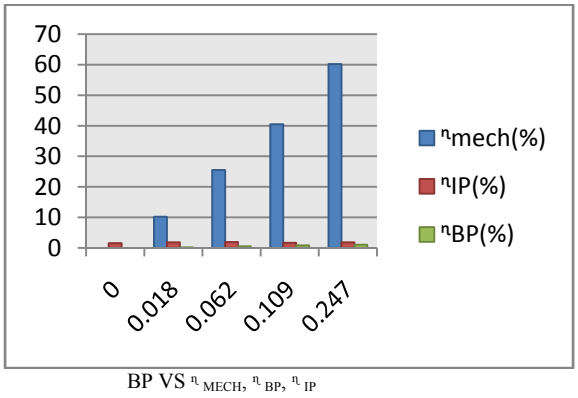


BP VS η_{MECH}, η_{BP}, η_{IP}

Fig. 4 Previous performance of truck air filter



BP VS η_{MECH}, η_{BP}, η_{IP}

Fig. no. 5 New performance ofautomation in truck air filter cleaner

Further study of Tabel 3 & 4 filter the initial change in Specific fuel consumption decreased in clogged type air filter as resulted in higher in efficiency of the engine, as with introduction of proper cleaned air filter of same model with same specific fuel consumption the efficiency of the engine validated, where there 0.7.5 % increase of efficiency. At constant speed of 750 rpm with different same load conditions in both filters the efficiency of break thermal is increased with 1.07 % but as load increases after 4 kW the efficiency slightly decrease, this is due to observation of in sufficient air supply / proper fuel burning. Comparing the case 1 and case 2 of cleaned filters resulted well in efficiency with their own advantage. Even study continuing for buses with clogged and cleaned air filters resulting good as compared with previous models. However, only by proper cleaned air filter can keep engine running at its best. Studies have consistently shown that vehicles with proper clean air filters perform better than dirty old air filters. A dirty and clogged air filter reduces the amount of air flow available to engine. A limited amount of air causes a drop in performance as well as other problems. Additionally, damaged air filters can allow small particles to enter in engine, causing additional problems. As comparing with results with other studies the improvement with a cleaned filter ranged from 2 to 5%.

4. Conclusion

The life of an engine is determined by the rate at which it ingests abrasive contaminants. Approximately 1 gram of dust per HP is sufficient to destroy an engine. Unlike the human body, which has different filtration systems and sensors to warn of bad air, the Air Filter is the only protection on an engine against potential damage. It has one chance, and one chance only, to remove the dust. The engine will find it difficult to breathe due to high restriction - reducing power output and increasing fuel consumption. So we clean the air filter in correct manner for increase the air flow into the engine for the combustion. This will increase output and reduce the fuel consumption.

References

[1] John Thomas, Brian West and Shean Huff, Effect of Air Filter Condition on Diesel Vehicle Fuel Economy, SAE International ,2013.
[2] Tadeusz Jaroszczyk, Scott W. Schwartz, Stephen L. Fallon, Development of high dust capacity, high efficiency engine air filter with nanofibers, 34th International Congress on Power train and Transport Means KONES 2008 .
[3] B. Pavan kumar goud, Dr.S.Chakradhara goud Experimental and numerical study on performance of air filters for diesel engine. International Journal of Engineering Science and Innovative Technology ,Volume 3, Issue 6, 2014.
[4] Sulay N. patel, Dr. Pravin P. Rathod, Prof. Arvind S. Sorathiya , Effects of air filter type and condition on performance and emission of four-stroke S.I. gasoline engine- Review study, International Journal for Scientific Research & Development Vol. 1, Issue 1, 2013 ISSN: 2321 0613.
[5] Maris Gailis, Vilnis Pirs, Research in influence of engine air filter replacement periodicity, Engineering for rural development, jelgava, 2011.