ISSN 2395-1621

Effect of blow by hot gases recirculation and crankcase ventilation on emission and engine performance

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ABSTRACT

The major pollutants likes Carbon Monoxide (CO), Hydrocarbon (HC), Nitrogen Oxides (NOx) emitted from two wheelers to exhaust due to incomplete combustion. From past few years, the various emission control techniques are air induction system to exhaust port for CO and HC reduction and after burn system viz. catalytic convertor. The engine is running at variable speed and variable load. The blow by gases are those which are escaping petrol fumes from combustion chamber through between the piston ring and cylinder, either in between piston ring and groove side or through ring gap to the crankcase. Also oil vapors are produced in the crankcase. The environmental effect of blow by gases is emitting the hydrocarbon to the environment. To balance the engine crankcase air pressure and atmospheric pressure crankcase ventilation system is developed. Through this ventilation HC emitted to environment. The test carrying in single cylinder air cooled four stroke petrol engine having bore and stroke 50.00mm X 52.00mm respectively. The displacement of engine is 102.1cc.The performance factors are directly related to atmospheric condition, so comparison between engines should be performed at similar atmospheric conditions. An attempt has been made here for experimentally evaluating the engine performance and engine emission by recirculation the blow by gases to combustion chamber. The performance and emission data analysis also it presents graphically such as thermal efficiency, brake specific fuel consumption, inlet air temperature, emissions such as HC and CO.

Keywords— Petrol engine, Blow by, Crankcase Ventilation, HC, CO.

ARTICLE INFO

Article History

Received :28th Septmber 2015

Received in revised form : 6th October 2015

Accepted : 8thOctober , 2015

Published online :

12th October 2015

I. INTRODUCTION

In recent years, as a concern of environmental issues grows, demands for reduction of emissions from motorcycles have increased. Pollutants are because of the incomplete burning of the air-fuel mixture in the combustion chamber. The major pollutants emitted from the exhaust due to incomplete combustion are,

1. Carbon monoxide (CO)
2. Hydrocarbons (HC)
3. Oxides of nitrogen (NOx) [1]

There are various emission control techniques/systems provided to control exhaust emission.

Following are some of them used in two wheelers,

1. Air induction system to exhaust port for CO and HC reduction.
2. After burn system viz. Catalytic Convertor.
3. Use of Non Asbestos material [10].

Most of the blow- by flows between the piston ring contact surfaces and the cylinder wall. Fig.1 A small amount of blow-by escapes in to a crankcase along the sides of the groove behind the piston ring. The amount can suddenly increase at high speed and low load, however, due to axial ring flutter particularly in petrol engines.gas can also escape to the crankcase through the valve guides and possibly also via the bearings of the turbocharger. When the engine is operating, some combustible mixture gas and exhaust gas can creep into crankcase by means of piston ring. So the engine oil will be diluted because of the mixture gas's coagulation.

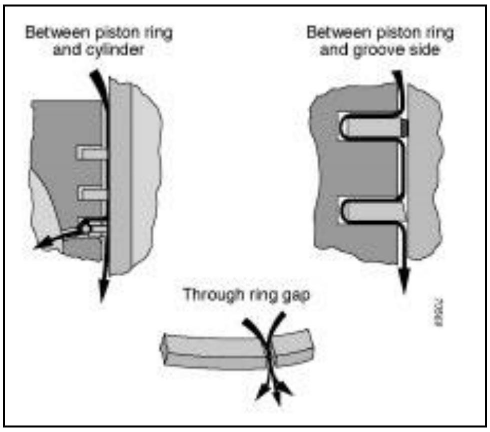

Fig1. Blow-by flows [5]

Crankcase ventilation systems are designed to control the balance of air pressure between the engine crankcase and atmospheric pressure while processing the accompanying fumes. Crankcase air pressures that are excessively above or below atmospheric pressure can have negative effects on component life, the lubricating oil system and overall engine emissions. Ventilating the engine crankcase is not a difficult process in itself. Controlling emissions and preventing contamination, however, add some complexity to this system [6].

II.TESTING METHOD

Most of the performance factors are directly related to atmospheric conditions, so comparison between engines should be performed at similar atmospheric conditions. The tests on I.C. engines can be divided into two types:

A) Variable - speed test.
B) Constant - speed test [11].

A) Variable-speed test:

Variable - speed tests can be divided into full - load tests, where maximum power and minimum s.f.c at each different speed are the objectives, and part - load tests to determine variation in the specific fuel consumption.

1) Full - load test with SI engine :

The throttle is fully opened and the lowest desired speed is maintained by brake load adjustment. The spark is adjusted to give maximum power at this speed. The test is started by the watch governing the fuel consumption, the test ended at the time the fuel- consumption test has been completed. During this interval of time, the average speed, brake load, temperatures, fuel weight etc., are recorded, and then load is adjusted for the next run at different speed. After the completion of the test, the required results are calculated, and performance curves are drawn.

2) Part - load test:

To run a part - load test at variable speed, say load, power reading of half the maximum power at each speed are obtained by varying the throttle and brake setting.

B) Constant-speed Test:

Constant speed test is run with variable throttle from no load to full load in suitable steps of load to give smooth curves. Starting at zero load, the throttle is opened to give the desired speed. Then a load is put on the engine and the throttle is opened wider to maintain the same constant speed as before, and the second run is ready to start. The last run of the test is made at wide-open throttle.

Single Cylinder Petrol Engine - variable Speed Test. The aim of the variable speed - variable load test is to obtain the variation of basic engine characteristics during the loading of the engine by the dynamometer white the engine speed is changing with load.

The basic difference of variable speed and constant speed is that the throttle of the engine is fully open during the whole test. Therefore as the load is increased, the throttle cannot be opened wider to maintain the same constant speed since it is already fully open. As a result of this, the engine speed will gradually drop as it is loaded.

This case may also be visualized in real life. Consider a car going with maximum speed on a flat road. Here maximum speed corresponds to the fully pressed gas pedal, therefore fully opened throttle. speed will begin to drop since the driver cannot press the gas pedal more which is already fully pressed. So this test will begin at fully opened throttle position at nearly no-load condition. Then the load will be increased gradually [11].

III.EXPERIMENTAL SETUP AND INSTRUMENTS

The test carrying in single cylinder air cooled four stroke petrol engine having bore and stroke 50.00mm X 52.00mm respectively. The displacement of engine is 102.1cc.

TABLE I

1.	Make	Honda
2.	No. of Cylinder	Single
3.	No. of Stroke	4
4.	Bore and Stroke	50.00 X 52.0 mm
5.	Displacement	102.1 cm3
6.	Type of cooling	Air Cooled
7.	Power	7 bhp@7000 rpm
8.	Idle engine speed	1700
9.	Compression ratio	9:1
10.	Lubrication system	Wet Forced

Fig2. Test rig

Fig3. Dynamometer Specification

The instruments are as follows

1. Fuel flow meter
2. Eddy current dynamometer.
3. Emission measuring Instrument (Gas analyzer)
4. Test rig.

IV.STATICAL ANALYSIS

The Quantity of Blow-by; how it is: The simple answer to this is “it varies”. The problem is that it varies depending on so many things that the accurate answer can be a complex one. Thankfully, for the purposes of this article there are some broad simplifications that can be made. Firstly, let us break down blow-by into two variables: The volume of air that your engine is ingesting and the blow-by rate.

It is easy to make a simple calculation to roughly determine what volume of air your engine in breathing:

N = engine speed (in RPM)

S = engine displacement (in liters)

V = volume of air being used by engine (in liters per minute)

V = (N x S)/2

Equation 1: Simple volume of intake air per minute.

There are other sources of blow-by:

Air leaking into the cam cover via the valve guides and seals in pressure-charged engines. The other variable, the blow-by rate, is a percentage, which expresses how much of this air leaks past the piston and into the crankcase. It can only really be determined through direct measurement but good rule-of-thumb figures are:

0.5% - New engine, after run-in.

1% - Design target for breather sizing.

2.5% to 3% - Maximum (e.g. for a worn engine, or poor piston ring sealing) [3].

Therefore, we can have a rough attempt at calculating the amount of blow-by gases entering your crankcase by multiplying the air volume by the blow-by rate.

Example: Worn out 1.6 liter engine at 6500RPM

S = 1.6

N = 6500

Blow-by rate = 3% (0.03)

V = (1.6 x 6500 x 0.03)/2= 156 liters per minute.

Equation 2: Simple blow-by volume [8].

V. CONCLUSIONS

With respect to the subject Effect of Blow-by hot gasses recirculation and crankcase ventilation on emission and engine performance, literature survey has been done Test set up, testing procedure, experimental study, statical analysis we discussed here.

ACKNOWLEDGMENT

I would like to take this opportunity to pay my profound gratefulness and express my sincere gratitude to my guide.

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