Reduction Of Engine Contamination And Improvements In Engine Efficiency

K.Vinoth Kumar[1], R.Siva Sankar[2], and M.Raghul[3],

[1]*Assistant Professor, Department of Mechanical Engineering,R.M.K College of Engineering and Technology, puduvoyal,Tamilnadu, India.*
[2] *UG Student, Department of Mechanical Engineering,R.M.K College of Engineering and Technology, puduvoyal,Tamilnadu, India.*
[2] *UG Student, Department of Mechanical Engineering,R.M.K College of Engineering and Technology, puduvoyal,Tamilnadu, India.*

Abstract: *Engine is an assembly of nearly 186 parts or components either machined or forged or casted. When a component at final stage requires a many no. of machining operations performed, which leads to formation of burrs. These burrs get settled deep inside of the components like holes, gaps or underneath of the machining area. When engine is assembled and oil is circulated , they get off from there and move to the moving area like piston & cylinder head & block , Crank case , Cam shaft etc. When engine runs they make the wear & tear of material. Contamination and Aesthetics are the major prevailing problems faced in recent trends in the automobile and automotive industries. to reduce this effects and problems, a study has been made and the problems are analyzed with appropriate methods. Hence various optimum solutions are derived and are implemented to achieve the maximum efficiency and productivity of the company*
Keywords*: Engine, contamination oil, automobiles,*

I. INTRODUCTION

Every object or a component which is nature or designed by human has an end period or failure time. We as engineers try very hard to find the life time and make many designs to reduce the failures and increase the life time. This is to increase the maintain the economic rates lower and increase the efficiency of the component. As of same every component in an engine has a unique feature and efficiency. Parts of a engine are manufactured by either forging, machining, or casting. Forging is done for shafts and bolts & nuts. Machining is done for screws, Cylinder heads, cylinder blocks, crank cases, cover cases and crank & Gear shafts. Casting is done for cam shafts and engine outer bodies. Each and every component has a unique order of processing. It follows and order of either casting or forging and machining.

Painting is also done for the various parts like cylinder heads, cylinder blocks and cover cases, and crank cases. Painting is also done in two ways. They are Powder coating, and robotic painting. The machine setups used Jost Hozen and Laquer machines.

Engine life time is considered under various factors. Each and every factor has a unique specification and definitions. They are the engine emissions, engine heat production and transfer, wear and tear of inner parts, replacement capability of the components, and engine dust contaminants etc,.

Among these contamination levels is the major defect causing factor. Since the remaining all factors are considered with contamination. Hence the reduction of contamination is the major criteria of increasing the engine life time.

II. PROBLEM STATEMENT

2.1 Problems In Existing Scenario:

Engine is a assembly of many no. of machined components. For small machined components, Burr is formed. This burr is removed as scrap by air & cleaning operation. Even though very minute burr gets settled in the weak areas and gets out when the oil circulates after the engine assembly.

2.3 Contamination In Engine- Primary Problem:

Due to contamination caused in the engine, the engine run with lots of problems like wear & tear, Huge noise, Friction, Vibration etc, of internal parts of the engine. These burrs are the major factor for the contamination caused in the engine assembly.

2.4 Engine Aesthetics Issues- Secondary Problem:
To improve the engine aesthetics and enhance the customer satisfaction and maintain the standard to the norms followed. Engine assemble has a audit were many defects are formed which makes the demerit score high.

Due to this customer dissatisfaction is going high. To control this certain methodology are followed & maintained.

III. METHODOLOGY

3.1 System of Engineering and Standards
3.1.1 Contamination Assessment Of Engine Oil - Test Procedure & Acceptance Criteria
To determine the weight of contaminants contained in the drained engine oil from engine assembly after warm-up.

This method doesn't quantify the contamination left out inside the engine, even after draining the oil. It is not applicable to castings or finish machined components, Sub- assemblies after final washing & just to prior to assembly.

This method involves warming up the engine, draining and collecting the oil in clean tray, filtering solid materials with 400-mesh size and determining the weight of contaminant level in two wheeler engines.

3.2 Test Facility Required:
- Nylon Cloth filter 400meshsize
- Millipore apparatus Glass tray Beaker
- Wash fluid(gasoline) Drier Oven Weighing Machine

3.2.1 Test Sample:
Evaluation needs to be carried on new motorcycle engine or vehicle from protection fresh or after initial run as mutually decide by Research & Development, Quality and Assurance Department ,Production Department.

3.2.2 Test Procedure:
Take fresh 400-mesh nylon cloth(mesh size in diagonal < 100micron) filter in completely clean & dry Condition of size 65mm*65 mm. The filter cloth must be washed in petrol and dried in oven for2hrs before taking up for initial weight measurement.

Weigh the filter in precision balance in grams with 4digit places after 35 minutes and before 40minutes of taking out from the oven. Note down the weight ,Say W1 gms.Warm up engine, as vehicle on road in all gears till oil temperature reaches about 600 Celsius.

Immediately drain oil sample through drain hole (by opening drain plug) into the clean glass tray after switching off the engine draining the oil should not be delayed by more than 1minute as it would cause suspended particles to settle.

For vehicle level testing of engine oil contamination, the vehicle should be tilted by using side stand and oil should be drained completely, shake vehicle or engine if necessary to remove all oil present. Collect the oil in clean glass beaker/ conical flask/ tray.

Place the filter cloth of size 65mm * 65mm on the Millipore apparatus to filter the oil, collected from engine.

Clean the strained with petrol & add the contamination to the filter cloth. If required use petrol as wash fluid to clean the glass tray and make sure the engine residue get collected at the filter cloth. Engine oil containing petrol should not be added into the engine.

After draining oil completely take out the filter with residue and clean with pure petrol without letting the residue out. It must be ensured that all engine oil in filter cloth is completely removed with petrol.

Dry the cloth at 700 for 2hrs minimum in oven.

Weigh the sample after 35minutes & 40 minutes of removal from the oven. Note down the weight in the sample precision balance, say W2 gms.

Difference in weight (W2 - W1) grams provides the weight of contaminants. Report the difference as the weight of contaminants against our specification limit. Discovered the used in filter cloth after testing.

3.3 Specification & Acceptance
Criteria for contamination:

Table: 3.3 Formulated Expected Specification of Contamination in Engine

S.No	Part name	Specification (mg)
1.	Engine (Crank Case Side)	5
2.	Engine (Gear case side)	5
3.	Engine (Transmission)	10
4.	Engine (Differential)	10
5.	Engine	10
6.	Engine	10
7.	Engine	5

3.4 FVPA-Final Vehicle Product Audit
FVPA stands for final vehicle product audit.
Developed at international automotive research centre for enhancing the individual markets.

Customer identifies only 3 defects from his knowledge.
Whereas the expert identifies at least 20 to a maximum of 50 to 60 defects in the same product with his knowledge.

3.4.1 Divisions of FVPA:
Process assessment: observing
Judgment criteria: analysis & observation

3.4.2 Demerit score rating of the FVPA method:
Demerit score is described and established by Warwick University, U.K.

Table: 3.4.2 Denoting the demerit score for the various types of defects found in the existing model.

Details /score	Assessment	Response in Audit	Corrective action
200	Safety/ regulations tocontrolled immediately	Stopvehicle dispatch	Check all vehicles & take care action to prevent reoccurrence
50	Major customer complaint/high TGW	Concern must be corrected to all vehicles	Implement of corrective action to prevent reoccurrence
15	Avg.Customer complaint/low TGW/ Showroom condition	Impact to be reduced	Improvement of ideas to be done
5	Customer observation	Considered as improvement	Depending on frequency
1	Complaint from the Trained observation	To be improved in Future models	Observe to Avoid deterioration

IV.   OBSERVATION &DATA-COLLECTION:

4.1 Data-collected on the basis of checking contamination in fresh oil:
Table:4.1 Contamination test on Engine Fresh Oil during Filling for over a period of 6-days with the variation from 12.7mg to 1.5 mg.

S.No	W1 (g)	W2 (g)	W2-W1(mg)
1	0.1663	0.169	3
2	0.1926	1947	2.1
3	0.2004	0.2036	3.2
4	0.1979	0.2001	3
5	0.1412	0.144	3.8
6	0.1627	0.165	2.3
7	0.1683	0.175	6.7
8	0.1477	0.15	2.3
9	0.153	0.1645	11.5
10	0.17	0.1774	7.4
11	0.158	0.1711	3.1

12	0.156	0.1658	9.8
13	0.1976	0.2095	1.9
14	0.1763	0.2033	**12.7**
15	0.1694	0.174	4.6
16	0.1511	0.155	3.9
17	0.1597	0.169	9.3
18	0.1594	0.163	3.6
19	0.168	0.176	8
20	0.173	0.1812	8.2
21	0.171	0.1799	8.9
22	0.187	0.1895	**1.5**
23	0.1726	0.1782	6.6
24	0.1527	0.1572	5.5
25	0.157	0.1635	6.5
26	0.1716	0.173	2.4
27	0.1726	0.1924	10.8
28	0.1815	0.1846	3.1
29	0.1474	0.1492	1.8
30	0.1826	0.1862	3.6

4.2 Observation:
Observation of defects & implementation of methods analysed

4.2.1 Observations on markings and labeling in assembly line:
✓ Markings are made in front side of stator side.
✓ Front side partially covered by bar code panel and back side of the engine
✓ Marks on petrol, carburetor and wiring with green colour.
✓ Mark on R.H starter motor covered.
✓ Mark on cylinder head covered
✓ Mark labeled inside the 82dia hole.
✓ Mark on kicker rod.

4.2.2 Observations on markings and labeling in test line:
✓ Number mark on wiring on engine.
✓ Mark on engine top.
✓ Mark on L.H Crack case partially covered by bar code label.
✓ Mark on engine number tag.
✓ Mark on carburetor inlet end.
✓ Mark on R.H. Crank case not visible went down of the assembly view.

4.2.3 Observations on markings and labeling in individual components:
Cover magneto:
✓ Mark on outside at the bush hole top side
✓ Marking on R.H. Side at outer side.

Crank case:
✓ R.H: at right side front of cylinder side.
✓ L.H: at backside side top.

Cylinder block:
✓ At top side.
✓ At dia82 left side face down.
✓ At dia82 inside of the bore covered in assembly.

4.2.4 Observations on markings and labeling in engine assembled line of star model:
✓ At R.H back top side
✓ Marks on carburetor.
✓ Cylinder head left side.
✓ R.H. Crank case cover bottom.

4.2.5 Observations on markings and labeling in engine assembled line of sport model:
- ✓ Mark on engine back top side
- ✓ Mark on stator motor
- ✓ Marks on carburetor & air inlet end.
- ✓ Marks on R.H. Down is invisible
- ✓ Marks on front side of number tag on R.H
- ✓ Marks on cover magneto L.H top side.

4.2.6 Observations on markings and labeling in engine assembled line of victor model:
- ✓ Mark on R.H top side
- ✓ Mark on carburetor and number printed on it.
- ✓ Mark on cover magneto R.H. Side front
- ✓ Mark on L.H. Side on number tag area
- ✓ Mark on L.H. Cover magneto.

V.   ANALYSIS

5.1 Analyzed Method Of Washing And Filtration Process:
5.1.1 Significance of washing all parts
- ✓ No parts are washed
- ✓ Only small parts washed

5.1.2 Significance of washing big parts with small parts
- ✓ All parts washed with petrol
- ✓ All parts washed using washing machine and finally washed with petrol.

Table: 5.1 Contamination by reduced from a variation of 32 mg to 5mg.

S.No	Small parts used without washing			Small parts washed & big parts ashed		
1.	141	155	14	138	152	14
2.	131	146	15	158	174	16
3.	148	158	10	151	166	15
	All parts washed without petrol			All parts washed with Petro-Air Wash		
4.	201	219	18	209	240	31
5.	221	244	23	210	226	16
6.	199	215	16	215	226	11
7.	191	207	16	205	213	8
8.	207	239	32	191	196	5

INTERPRETATION:

From the above Tab-5.1, it is found that regarding all types of washing, the washing with petrol and air wash is more effective than the others. using the petrol and air wash the contamination levels are derived at 5 mg which is reduced from a maximum of 32 mg.

5.2 Analysis on aesthetics Data from concern sheet and demerit scoring:

Table: 5.2 Demerit Score rating using the Concern sheet by Observing the defects.

Concerns	Defects	Demerit score
Fasteners	1.Visible	1
	2.Appearance	5
	3.Incorrect	1
	4.Loose fitment	1
	5.Missing	1

	6.Damage	1
Colour /grain harmony	1.Interfacing components	15
	2.Fasteners with interfacing	5
	3.Grain harmony with interfacing	5
Moulding defects	1.Ejector score	5
	2.Parting line	15
	3.Sharp edge	5
	4.Surface waviness	1
	5.Flash (plastic) , burr(metal)	1
Paint defects	1.Uncoverage of paint	15
	2.Rundown/chip off/flow mark	50
	3.Peel of on plastic parts	50
	4.Paint crack	5
	5.Visual quality of masking line	5
	6.Paint deposition on parts	1
Weld finish	1.Weld virtual quality on exposed parts	15
	2.Unexcess weld bead size	5
Handling defects	1.Scratches	15
	2.Dents	15
	3.Damages	5
	4.Cut marks	1
Visual expectation	1.Visual quality of rubber parts	5
	2.Deformation & un excess compression	5
	3.visibility of gasket protrusion	15
	4.Component surface finish	1
	5.Exposed thread	50
	6.Unwanted markings	15

VI.   SUGGESTIONS

6.1 Suggestions to decrease Contamination:
- ✓ A time scale has to be maintained to
- ✓ interchange the used filters to new ones.
- ✓ Damaged filters are to be replaced immediately.
- ✓ Proper maintenance has to be given to the pump circuits.
- ✓ All parts washed with air pressurized wash and petrol wash before assembling in the conveyor line

6.2 Suggestions To Decrease Demerit Score:
- ✓ Reduce the depth of the Drilling and Tapping done in the cylinder head area at the L-Cover side where the material is removed in excess at the Open Through hole side.
- ✓ Proper Insertion of dummy pin Clutch Cover to avoid the damage of the component -- usage of Pneumatic Hammering tool or Hydraulic Hammering Machine.
- ✓ Reduce the size of the markings on the visible area to customer.
- ✓ Change the area of markings
- ✓ usage of temporary marking tools while the markings are erased when the vehicle is dispatching.
- ✓ Proper Guidance to be given to the Painting Authorities to maintain even area of painting on the components.
- ✓ Reducing the defects of Paint un-coverage at the ends of the components.

✓ Proper guidance to work men in machine shop is to be given in handling of components to avoid the paint chip-off and paint run down at the blind edges due to metal to metal contact and sudden forced placing of components in the fixtures.

✓ Reducing the sharp edges to eliminate the finger traps and increase the safety.

VII.   OPTIMUM SOLUTION

From the above possible solutions, Usage of the Petro-Air Wash system is best efficient in reducing the contamination from the maximum of 32mg to 5mg in the various series of testing done. hence it is stated that the system of washing in Petro-Air model reduce the contamination.

All parts washed with air pressurized wash and petrol wash before assembling in the conveyor line
Reduce the depth of the Drilling and Tapping done in the cylinder head area at the L-Cover side where the material is removed in excess at the Open Through hole side.
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VIII.   IMPLEMENTATION:

8.1 Implementations in contamination Issue:
Development process of washing criteria in the sub-assembly and main line assembly in the engine unit.

With the analyzed and observed data, here it is found that the usage of air pressurized wash and petrol wash of all the components in the sub-assembly line is the best method to reduce the contamination causing factor. Since, Petrol and pressurized air has the capability of cleaning of the minute particles and oil & messy products over the engine components.

hence with the above statement , the main problem of contamination is reduced from the maximum level of 31mg to 5mg. by this the method of air and petrol washing is implemented in the following coming days with the right approvals from both the Research & Development Departments as well as Operations Department.

8.2 Implementations in aesthetic issues:
The demerit score of the FVPA process is reduced by using the quality tools to find the root cause of the problem and implementation is done in reducing the demerit score of the engine assembled

IX.   CONCLUSION:

Hence by the usage of Quality tools the root cause for the problem faced with contamination is reduced by the usage of Petrol and Air wash done before assembly. With the help of the seven quality control tools we were able to identify the root cause for every defect and suggest suitable corrective and preventive actions for each. The project tested our basic theoretical knowledge and provided a platform to apply the same practically. It had been a knowledge quest for us. We sincerely thank the management of TVS Motor Company - Hosur division - Operations department who have given this wonderful opportunity to budding engineers like us to work for their prestigious company for a month. We are pretty sure that the quantum of knowledge that we gained here will be a valuable tool to our career.

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