Centrifugal Filtration Technology

for Diesel Engines

FloSolve

Case Study

KOMATSU 860E FILTER ON MAIN ALTERNATOR

> Increased performance, decreased maintenance, greener footprint!

Equipment Used For Testing

- **Anemometer to measure velocity**
- **Differential Pressure Gauge Meter**
- **Temperature Meter**

Introduction

Dust particles passing through the alternator with the cooling air is causing a wear effect on some of the internal parts of the alternator. A filter system is required to capture the dust particles before entering the alternator. The filter must fit in the space available and the pressure drop (air flow restriction) across the filter must be as low as possible.

Proto Type Filter System

The As18 Vortex Tube Filter System was designed to fit into the space at the inlet of the main blower. The pressure drop across the filter was kept to the minimum but still achieving high centrifugal action through the vortex tubes. This is visible on the graph attached (Graph 1) The scavenge blower was designed to extract the filtered dust from the filter and blow it back into atmosphere. The drawing and photo's attached show the general layout of the system and installation.

Test Preparations

Measuring points were discussed and 2 x holes Ø6mm were drilled to ensure that all necessary points were measured. All holes were closed after the tests. The temperature was measured before each test to normalize the results for comparison purposes. The Graph is drawn at 0oC and sea level conditions (101.3kPa). The formula to compare results is as follows

$$\frac{?Pa.Va}{ta} = \frac{?Pn.Vn}{tn}$$

Test Results

Airflow measurements were done before and after the fitting of the proto type filter system.

Before Fitting of Proto Type:

Velocity was measured at the inlet grid of the main fan for the cooling air of the main alternator. This was done at 80Hz and 100Hz.

Velocity @ 80Hz (V1) = 11.8m/s
Velocity @ 100Hz (V2) = 15.5m/s

The design volume flow for the AS18 Vortex Tube Filter was calculated from these measurements. (Volume flow (Q) = Velocity (V) x Area (A))

Q1 = 3.02m3/s (6392 cfm)
Q2 = 3.96m3/s (8396 cfm)

After Fitting of Proto Type:

Airflow and pressure drop measurements were taken to compare with the measurements taken before installation. The airflow of the scavenge blower is also measured to ensure it is operating between 7 – 10 % of the main air flow.

Filter inlet Velocity (V3) @ 80Hz = 6m/s
Filter inlet Velocity (V4) @ 100Hz = 8m/s
Scavenge Blower outlet Velocity (V5) @ 80Hz = 17m/s
Scavenge Blower outlet Velocity (V6) @ 100Hz = 22.5m/s
Pressure Drop of Filter (?p1) @ 80Hz = 220Pa
Pressure Drop of Filter (?p2) @ 100Hz = 340Pa

To determine the flow through the AS18 Vortex Tube Filter a standard graph is used. (Graph 1) This graph shows information for a single vortex tube. The information from the graph is converted to site conditions and multiplied by the amount of tubes in the filter to calculate the actual volume flow after fitting the AS18 Vortex Tube Filter System.

Calculation Results

Q3 = 3.01m3/s (Q3 = Volume Flow @ 80Hz)
Q4 = 3.78m3/s (Q4 = Volume Flow @ 100Hz)
Q5 = 0.3m3/s (Q5 = Scavenge Blower Volume Flow @ 80Hz)
Q6 = 0.39m3/s (Q6 = Scavenge Blower Volume Flow @ 100Hz)

For a cross check of the volume flow, the filter inlet velocity (V3 &V4) is multiplied by the area and the open to close ratio of the inlet screen. This calculation shows the following:

- Q3 (Calculated with V3) = 2.8 m3/s
- Q4 (Calculated with V4) = 3.7 m3/s

Komatsu 860Scavenge Blower is operating well and the percentages are as follows:

- @ 80Hz – 10 % Scavenge Air
- @ 100Hz – 10.3 % Scavenge Air 7.

Conclusion

The air flow through the main alternator has decrease from approximately 8396 cfm to 8006 cfm which reflect a loss of about5% in air flow. This confirms that the As18 Vortex Tube Filter System is operating according to our design where a pressure drop across the filter was estimated to be approximately 350Pa.

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