

RESEARCH OF AIR FLOW DEBIT WITH NEW CONSTRUCTION INNER LINER

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Filters were created to separate unwanted particles and hold them in filtering material. Filters can be used for gas filtration or liquid filtration. That's why filters are used in a wide range of fields. Since air filters trap unwanted particles, they can protect the human respiratory tract or some devices high precision inside elements. It depends where the filters are installed, in highly dusted premises or in other places such as engine/air compressor intake systems or etc. These filters protect devices from wear, contamination and extend length of life. Therefore, filters are used in various areas are divided into two main groups: 1. Industry (various ventilation systems, air compressors, space technology, personal computers, medical equipment, etc.) and 2. Transport (cars, agricultural machinery, trucks, planes, trains and etc.). For air flow modelling has been chosen transport filters main group.

Keywords: Air flows, air filter inner liner, air flow debit.

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INTRODUCTION

Many scientists investigate air flows, performing highly complex calculations [1,2]. It is necessary because sometimes impossible to measure air flow trajectories. During overview was found that there is not a lot of information about vehicle air filter flow analysis. Usually there are some measurements of the debit or pressure drop and etc. [3,4].

This study was based on the air filter construction, because if the air filters size is high, it is necessary to use some internal elements to increase filter strength. However an additional element changes the air flow trajectories and may affect intake air parameters. In order to improve the new filter characteristic it is necessary to make it with better permeability using the same type filtering material. It was done by the way of inserting a new design inner liner element.

RESEARCH OF THE NEW CONSTRUCTION INNER LINER ADVANTAGES AND DISADVANTAGES

Air filter inner liner is one of the most important component of its construction. Because this component acts as support structure and as air flow handling tool, which prolongs the life of the filtering material. Using „SolidWork 2014“ software, has been developed old type (Fig. 1 a) and new type inner liner components (Fig. 1 b).



a) b)

Fig. 1. Inner liner models printed from ABS plastic. a) original inner liner, b) new design inner liner.

Calculations were performed using “SolidWorks 2014” software. During the calculations was found that new design inner liner is 15 grams lighter and has greater rigidity (Fig. 2). Also it makes better air flow with lower air force resistance (Fig. 3). The new design inner liner has allowed using a wider volume of the air filter box (about 10%). However, this element creates lower air resistance of vehicle air intake system. Therefore the internal combustion engine can soak up the air with lower energy consumption. This phenomenon gives that engine can give back more power.

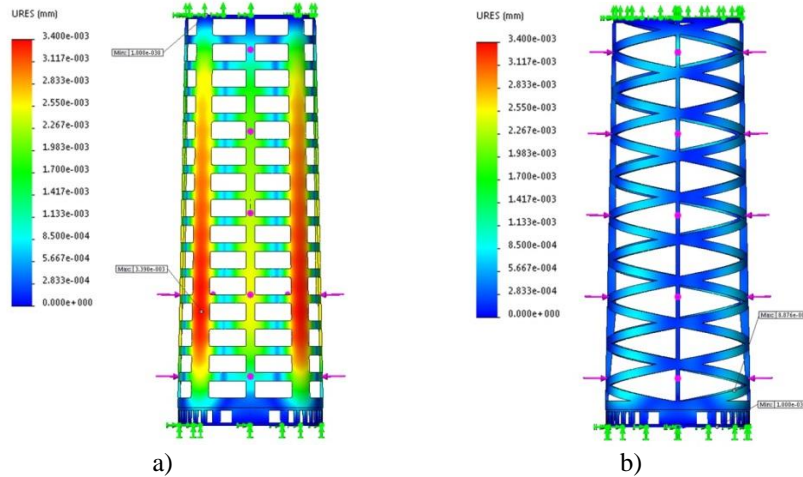


Fig. 2. Rigidity calculation results a) original inner liner, b) new design inner liner

Figure 2 shows the maximum displacement of the original inner liner component was about 0.0034mm (Fig. 2 a) and the maximum displacement of the designed inner liner component – about 0.00089mm. That means that original inner liner has about 4 times bigger displacements then designed inner liner. These results show that new design inner liner component has greater rigidity.

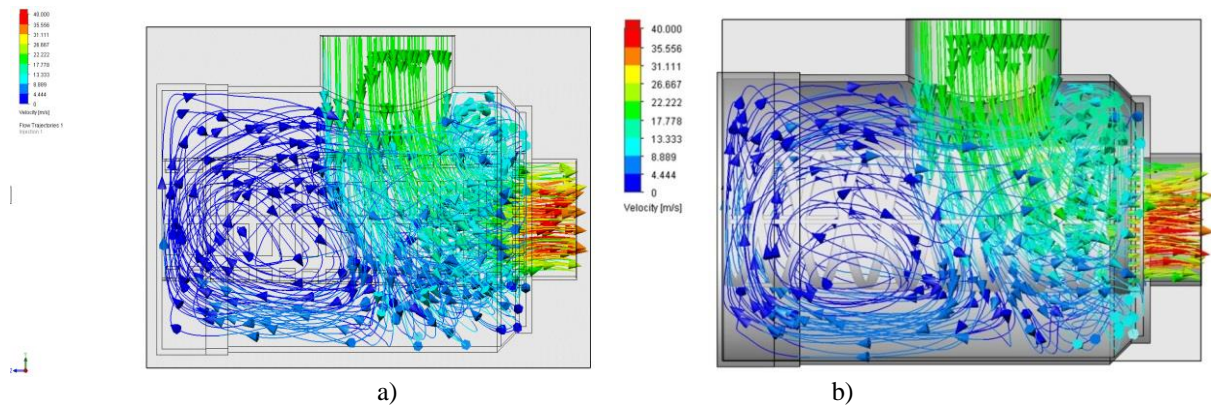


Fig. 3. Air flow simulation results: a) using original inner liner, b) using new design inner liner.

Air flow simulation results shows that air flow concentration in air filter housing became different. Using original inner liner element air flow lines more focused on the outside of the inner liner element. However using new design inner liner element air flow lines takes more space in air filter housing. That means that new design inner liner allow to use more space of air filter housing. These facts prove that the new inner liner element creates fewer obstacles to air flow.

EXPERIMENTAL FLOW RESEARCH OF THE AIR FILTER WITH NEW CONSTRUCTION INNER LINER

Printed models were transferred to the air filters manufacturing company “UAB MATURE”. This company assembled air filters with different inner liner elements and give back for experimental research (Fig. 4). Air flow debit measurements was caried out in Lithuanian Energy Institute.

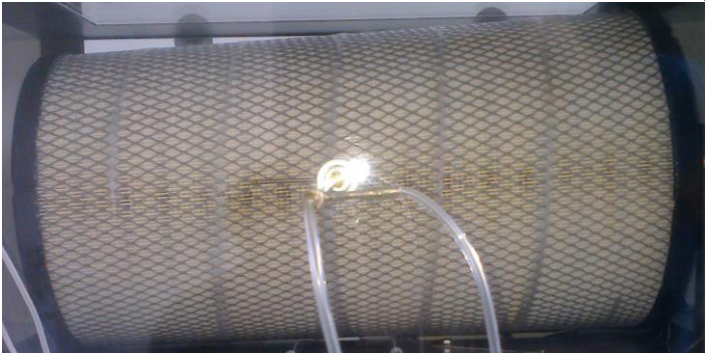


Figure 4. Assembled air filter



Fig. 5. Air flow simulation results: a) using original inner liner, b) using new design inner liner.

Figure 5 shows experimental setup of vehicle air filter housing. This housing was attached on air flow debit measuring device. During experiment was selected constant debit and measured pressure drop. This vehicle air filter must be changed when pressure drop reaches up to 6200Pa. Vehicle maximum intake air volume depends of the combustion engine working volume. Meanwhile pressure drop depends of air filter pollution. Therefore over the time air filter permeability became worse and worse. This is normal when the filter is used.

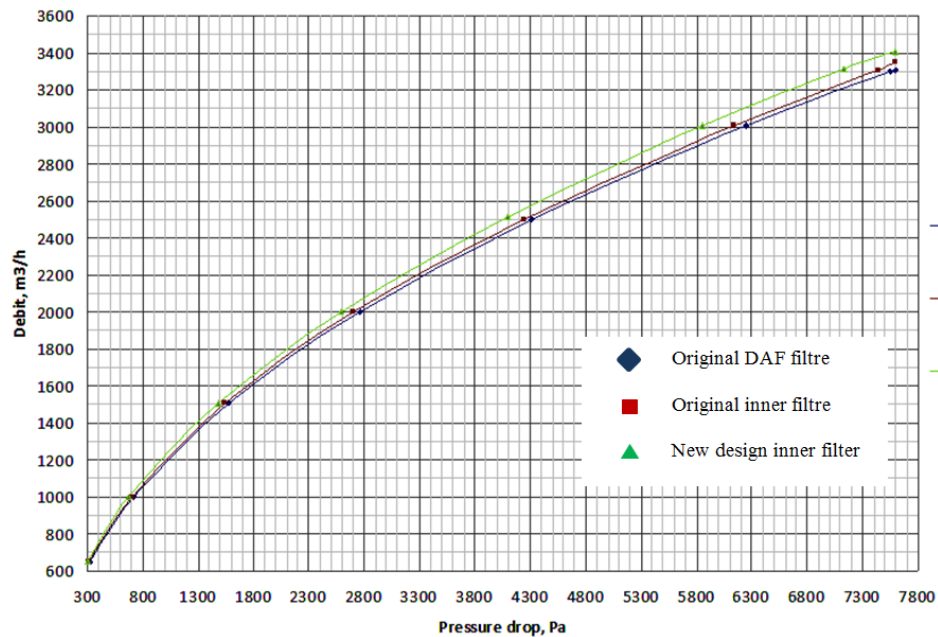


Fig. 6. Air flow debit results of the different air filter type.

In order to improve the new filter characteristic it is necessary to make it with better permeability using the same type filtering material. It is possible in two ways. First way – using higher plot area of the filtering material. Second way –insert a new construction inner liner element. Because a larger area of air filtering material was impossible to use, it was done using new construction inner liner element.

Measurement was done for the new air filters. Measurement results are shown at figure 6.

Figure 6 shows measured results of the three different air filters. First filter was taken from vehicle manufacturing company as original part. Another filter was created the same as original, but with new filtering material. The last one filter was created using new design inner liner.

After measurements were found that the filter with original inner liner and new filtering material spends out about 1.1% more air than original DAF Company filter. However air filter with new design air filter spends out about 1.9% more air than the filter with new filtering material but the same as DAF filter inner liner. It means that new design inner liner makes better permeability of the air. It happens because new design inner liner element has better design, and higher plot area of the cavities.

CONCLUSION

After many theoretical calculations was found that new design inner liner is 15 grams lighter, has greater rigidity and makes better air flow with lower resistance. The new design inner liner has allowed to use a wider volume of the air filter box (about 10%). New design inner liner has about 4 time's smaller displacements with the same load then original inner liner component.

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