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Numerical Studies of Air Flow Analysis in Compressed Air Filters

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Abstract

The filter is developed by placing the filter media in between the inner surface and the outer surface of the stainless steel fabrication. Then the study on the compressed coming out of the filter is tested and analysis is made by two methods. In experimental method, the analysis done for the output compressed air which is passed through the 5HP compressor and the pressure gauge which is placed on either side of the filter. The survey is also conducted to check the life span of the filter. In analytical method the results are obtained for the ANYSYS ICEPAK and ANSYS space claim software. Then the results of both methods are compared and the results are concluded.

Keywords: *Compressed air, compressed air filter, experimental and analytical methods, lifespan of filter*

1.0 Introduction

The principal occasion of an air blower utilized for some different option from fire the board appears in 1762, a "blowing chamber" controlled by a water wheel. It delivered an astounding 14 psi. A water-cooled rendition of this shows up in 1872. In 1857, labourers started penetrating a passage through the Swiss Alps the hard way.

In 1650, German scientist Otto von Guericke devised an air pump consisting of a single piston and cylinder. With it he was able to experiment with compressed air and vacuums. George Medhurst of England designed the first motorized air compressor in 1799 and used it in mining. A compressor is a mechanical device that increases the pressure of a gas by reducing its volume and reducing its volume. An air compressor is a specific type of gas compressor. Compressors are similar to

Pumps: both increase the pressure on a fluid and both can transport the fluid through a pipe. An air compressor is a mechanical device that increases air pressure by reducing volume. Air is compressible, the compressor reduces the volume of air and creates pressure in the air. An air compressor converts electrical energy into kinetic energy in the form of air.

1.1 Air Compressor

An air compressor is a device that converts energy (using an electric motor, diesel or gasoline engine, etc.) into potential energy air). In one of many ways, air compressors push more and more air into the storage tank to increase the pressure. When the tank pressure reaches the design upper limit, the air compressor is turned off. Compressed air is retained in the tank until it is used up. The energy of compressed air can be used in a variety of applications using the kinetic energy of the air released and decompressed from the tank. When the tank pressure reaches its lower limit, the air compressor turns on and depressurizes the tank. An air compressor should be

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distinguished from a pump as it works with any gas/air, while pumps work with liquid.

There are basically 5 types of air conditioner compressor that are commonly used in the HVAC industry:

1. Reciprocating
2. Scroll
3. Screw
4. Rotary
5. Centrifugal

There are several options to consider when purchasing a new compressor for an industrial facility. Piston compressors, screw compressors, and centrifugal compressors are the most common choices. The best option depends on the size of the installation and how compressed air is used.

Compressors can be classified according to the pressure delivered:

1. Low-pressure air compressors (LPACs) – which have a discharge pressure of 150 psi or less
2. Medium-pressure compressors – which have a discharge pressure of 151 psi to1,000 psi
3. High-pressure air compressors (HPACs) – which have a discharge pressure above 1,000 psi

They can also be classified according to the design and principle of operation

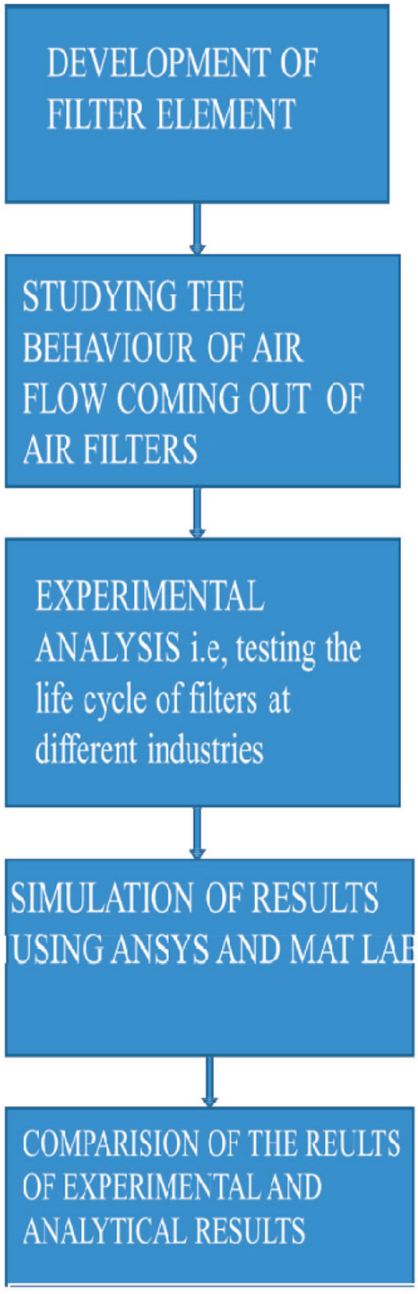
1. Single-stage Reciprocating compressor
2. Two-stage reciprocating compressor – compound compressor
3. Rotary-screw compressor
4. Rotary vane compressor
5. Scroll compressor
6. Turbo compressor
7. Centrifugal compressor

1.2 Airfilter

Particulate air filters are devices made of fibrous or porous materials that remove solid particles such as dust, pollen, mold and bacteria from the air. Filters containing sorbents such as charcoal or catalysts can also remove odors and gaseous pollutants such as volatile organic compounds or ozone. Some buildings, as well as airplanes and other man-made environments, such as satellites and space shuttles, use foam, corrugated card board or fibre. Alternatively, air ionizers use fibers or elements with static electricity to absorb dust particles. The air intakes on internal combustion engines and air compressors tend.

To use paper, foam, or cotton filters. Aside from niche applications, oil bath filters are no longer preferred. The gas turbine air intake filter technology has greatly improved in recent years due to improvements in the aerodynamics and fluid dynamics of the air compressor part of the gas turbine.

2.0 Methodology



2.1 Development of Filter Element

Step 1

In a first step machining of aluminium/plastic caps are done

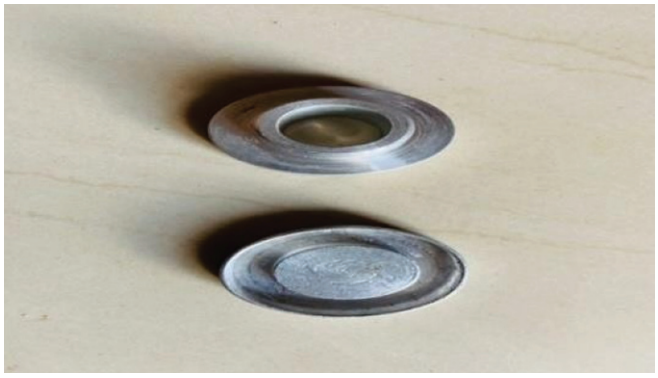


Figure 1: Aluminium plastic caps

Step 2

The outsourcing of stainless teel expanded metal sheet/ perforated metal sheet is done in this step and also the fabrication is done according to various sizes which includes inner and outer core

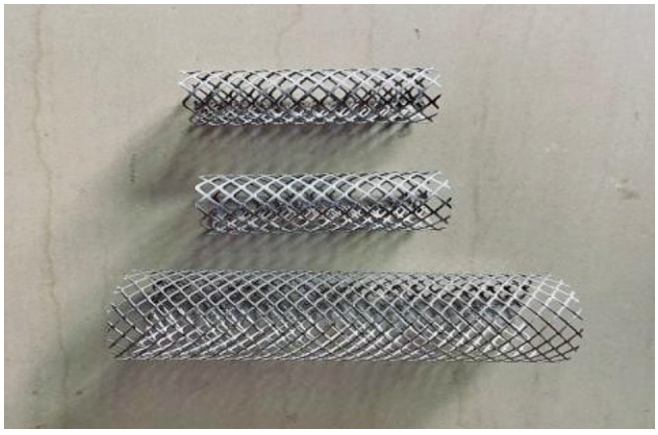


Figure 2: Metalsheet

Step 3

Filter media is placed in between inner and outer core, and it is rolled.

Figure 3: Filter media

Figure 4: Rolled filter media

Step 4

After rolling the filter media the polyurethane foam will be placed on the outer core

Figure 5: Poly urethene foam

Step 5

In this step attaching the end caps (with is made of aluminium) using food grade adhesive then it is left to dry for 24 hrs

Figure 6: Attachedend caps

Step-6

Finally this filter element will be placed inside housing and is ready to be used.

Figure 7: Filter element placed inside housing

2.2 Experimental Analysis

Here the test is done for obtaining the differential pressure (inlet pressure–outlet pressure) and it was conducted in CRS Industrial Enterprises. Test is done by installing filter to the compressor and placing pressure guage on either side of the filter.

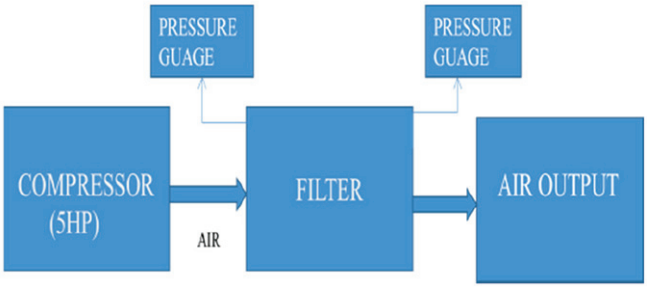


Figure 8: Experimental analysis

2.2.1 Specifications

2.2.2 Operating temperature

40ºC Pressure-7

bar (max 10 bar)

Compressor of 5 HP is used 1 HP = 3.4C Fm

So 5*3.4 = 17C F m air flow at the 7 bar pressure

It removes particle up to 0.01 micron

2.2.3 Results

Input

Velocity – 10m/s

Pressure – 6.6 bar

Temperature – 40ºC

Output

Velocity–15m/s

Pressure – 6.55 bar

Temperature–39.5ºC

- Differential pressure = input pressure – output pressure

DP = 6.6- 6.55

DP = 0.05

- Temperature variation is negligible
- Velocity remains constant

2.3 Model of a Filter

- The filter is modeled using CADCATIA V5 software

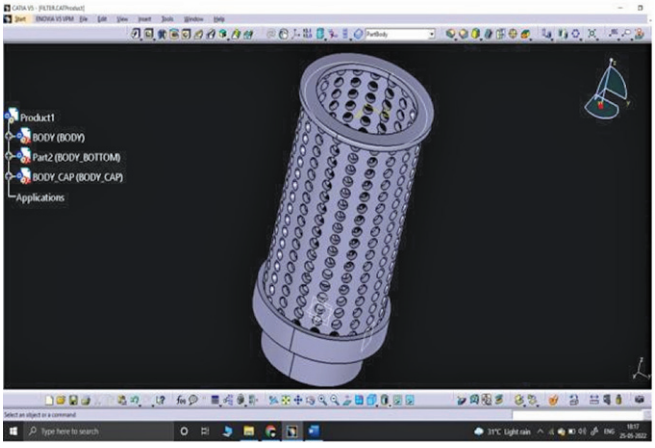


Figure 9: Filter model using CAD

Rendered images of model

Figure 10: Rendered cad model

2.4 Analysis Using Ansys Software

2.4.1 Specifications

To simplify the CAD model and spilt various surfaces, we use ANSYSS pace claim:

Performing thermal analysis: ANSYS Icepak
Number of iteration: 100 elememnts;
Hexahedral : Mesher HD
No. of elem: 48390
Node: 45774

2.4.2. Mesh control

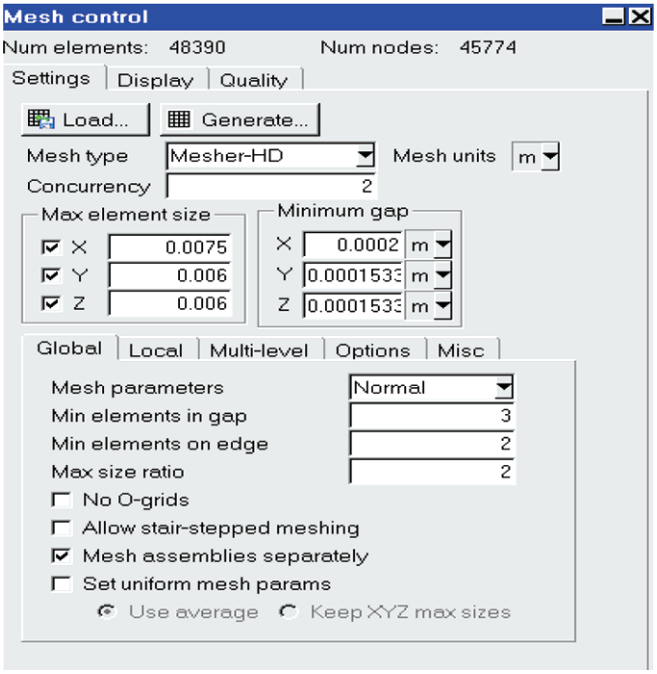


Figure 11: Mesh control

2.4.3. Basic parameters

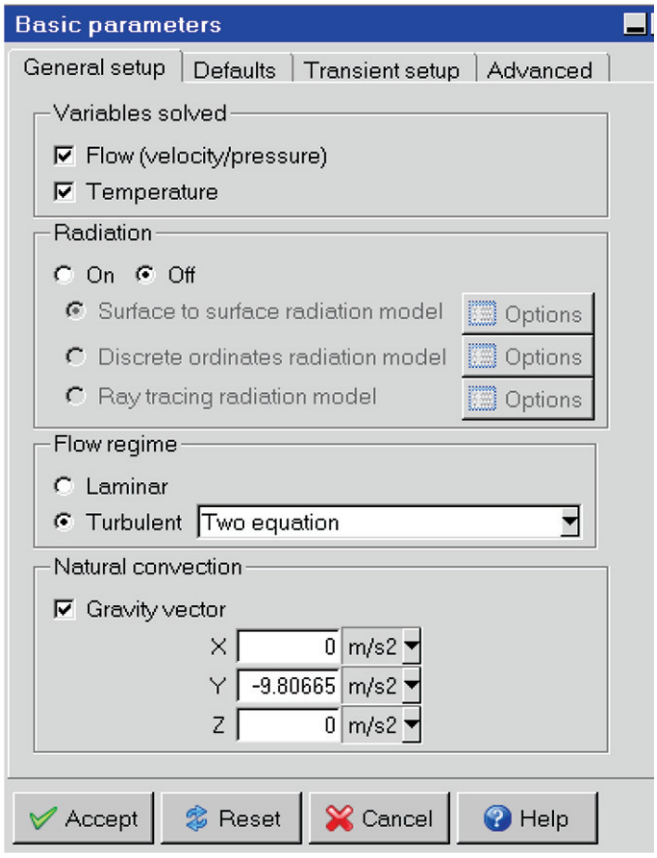


Figure 12: Basic parameters 1

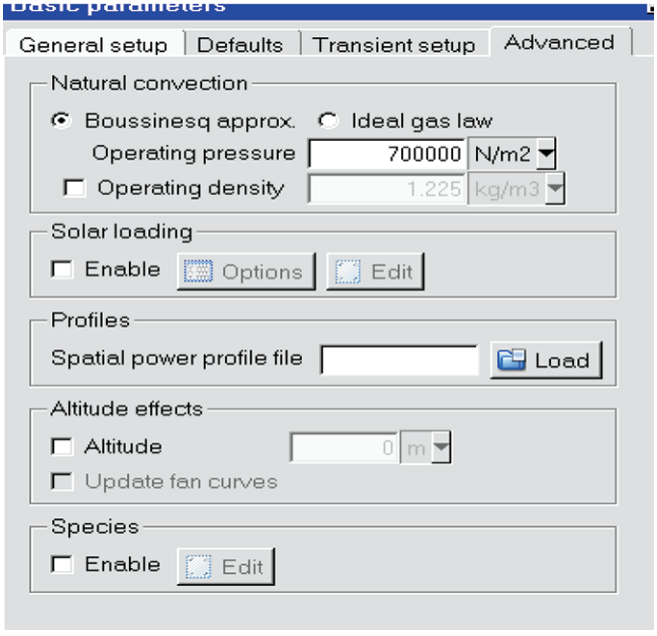


Figure 13: Basic parameters 2

2.4.4. Results

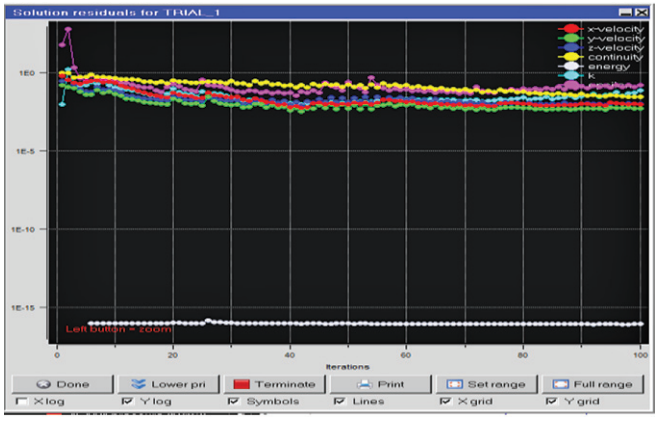


Figure 14: Velocity point monitors

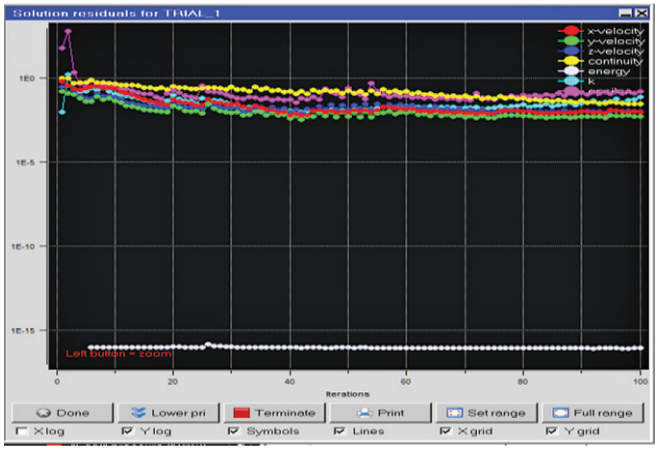


Figure 15: Solution residuals

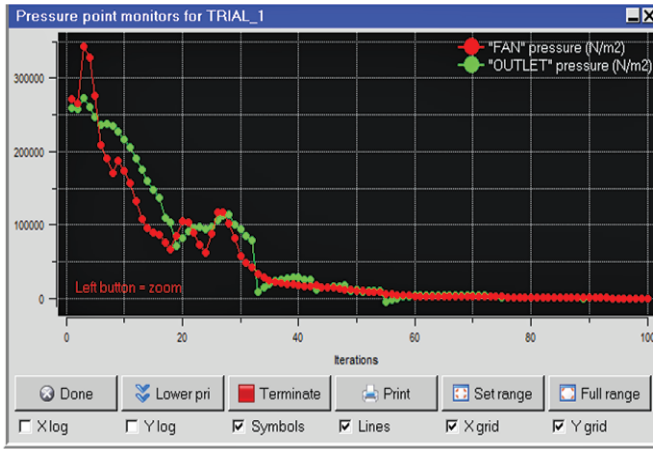


Figure 16: Pressure point monitors

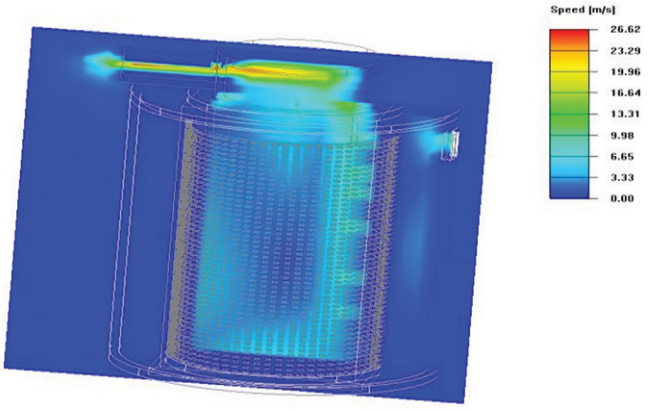


Figure 17: Colour contour for speed

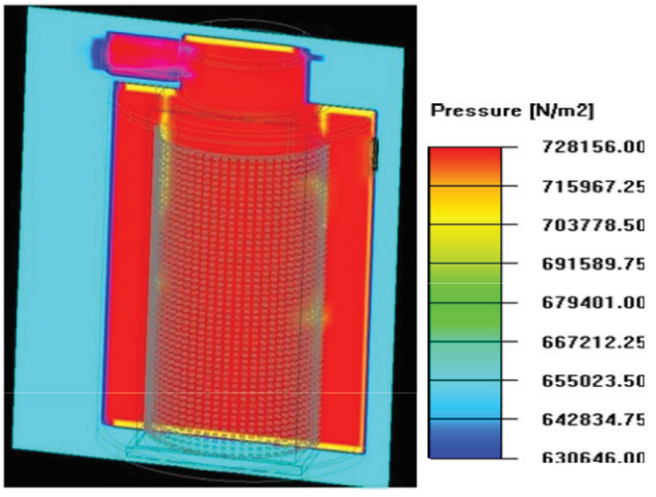


Figure 18: Colour contour for pressure

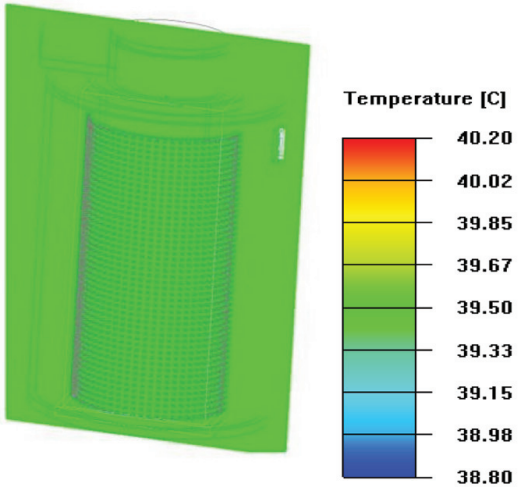


Figure 19: Colour contour for temperature

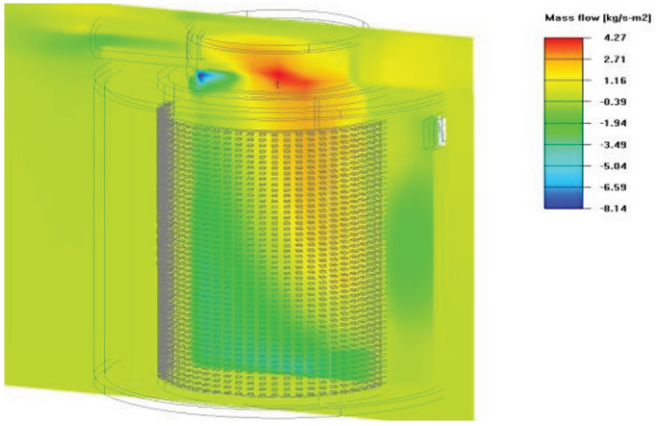


Figure 20: Colour contour for mass flow

Input

Velocity – 11m/s
Pressure – 6.5 bar
Temperature – 39.5ºC

Output

Velocity – 16m/s
Pressure – 6.3 bar
Temperature-39.5ºC

2.5 Survey

Survey of companies is conducted to know the life span of the filters

- Companies working with compressor for 8 hours per day can use filter for 10 months

Few companies surveyed are

1. CRS Industrial Enterprises
2. Nanjundeshwara Powder Coaters
3. Ashwini Coaters
4. MTR Foods

- Companies working with compressor for 12 hours per day can use filter for 7 months

Few companies are:

1. Gokuldas Exports
2. Bharatiam Foods

- Companies working with compressor for 24 hours can use filter for 3 and a half month

Few companies are

1. Nestle
2. Himalaya Drugs
3. Hikal Chemicals
4. Lanco Industries

3.0 Conclusions

The values are similar for the pressure drop from inlet and outlet which is called as differential pressure. There is a significant increase in velocity. The temperature has negligible drop. This filter removes all the dust particles, moisture, oil and other impurities which is close to 0.01 micron and suits the best in the industries which requires purified compressed air.

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