

Effect of Filtration and Self-Cleaning Filter In Air Conditioning

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1. Introduction

The planet's middling surface temperature has been ascended about 2 degrees Fahrenheit (1 degree Celsius) since the late 19th century, a change driven largely by increased carbon dioxide emissions into the atmosphere and other human activities. Most of the warming occurred in the past 40 years, with the seven most recent years being the warmest. The years 2016 and 2020 are tied for the warmest year on record. With the increase in temperature, the demand for domestic air conditioner has been surged significantly which also attracts higher energy consumption. To reduce the energy consumption globally, high efficiency air conditioners are desired, and many new areas have been researched to achieve efficiency in air conditioning. Heat exchanger is the vital part of an air conditioner and efficiency of heat exchanger is highly influential towards the efficiency of the complete system. A heat exchanger is precisely what the name implies, a device used to transfer (exchange) heat or thermal energy. Heat exchangers are either given a hot fluid to provide heating or a cold fluid to provide cooling. Most heat exchangers for HVAC purposes use convection and conduction. Radiation heat transfer does occur, but it makes up only a small percentage. The fluids used in HVAC system typically include water, steam, air, refrigerant, or oil as the transfer mediums. HVAC heat exchangers usually do one of two things, they either heat or cool air or water. Some are used to cool or heat equipment for performance reasons, but the majority are used to condition air or water. Most of the domestic air conditioners have finned tube coil heat exchanger where refrigerant flows through the coil and fins connected to the coils exchange heat to the air. People often ignore the filtration part of the air conditioner, which also serves a key role to the efficacy of the performance of a heat exchanger. In this article, the influence of filtration over the heat exchangers, has been explored. Moreover, to increase the efficiency, regular cleaning of air filter is desirable which is often difficult to maintain. An automatic system to clean the filter by itself could be an option to increase the efficiency which has been demonstrated in this article in addition.

2. Approach

A dirty air filter is a prime cause for HVAC system failure as it makes it harder for the air con unit to work properly and efficiently. A dirty filter restricts the airflow into the HVAC system and places an additional strain on the unit. Over time, the increased wear and tear can burn out the fan motor, overheat the system, and cause a complete breakdown earlier than it would. Whereas a properly maintained system can increase the lifespan of the system. Furthermore, a clean filter helps to stop dust and debris to build up on the internal components of HVAC system. Regularly replacing your air filter is required to increase the efficiency of HVAC. An air conditioner with a dirty air filter will lead to high energy bills as well. A clogged dirty air filter can cause a 15% increase in energy usage. HVAC system is going to occasionally cycle on and off throughout the day, but a dirty air filter can cause those cycles to become more frequent. Frequent cycling can lead to noise pollution, wasted energy, and uncomfortable temperature changes. A clean air filter will not impede air flow in and out of the unit. However, a dirty air filter will restrict the flow of cold air, causing it to build up inside the ac unit and lower the temperature. If the air filter clogs during summer cooling season, the build-up of the cold air can lead to ice forming on the ac coils or evaporator. The freezing will reduce the HVAC system's ability to remove heat from the air and eventually cause your air

conditioner to breakdown. Even if decreased air flow does not cause freezing the restricted airflow will not provide adequate cooling power. A dirty air filter results in less cool air and decreased comfort for people. Blower fans push air through the filter. A dirty air filter creates a layer of dirt, dust and dander that restricts the amount of air that the air conditioner takes in and placing a strain on the blower. The reduced air flow can create hot and cold spots in air- conditioned space, making it harder to reach the desired indoor temperature at an increased cost. To overcome this challenge, a self-cleaning filter can be introduced which would be placed behind the return air of the air-conditioning unit. The self-cleaning filter has a moveable brush which moves against the return air filter. It brushes off the filter periodically and the dust is accumulated underneath the filter panel which can be then vacuum cleaned.

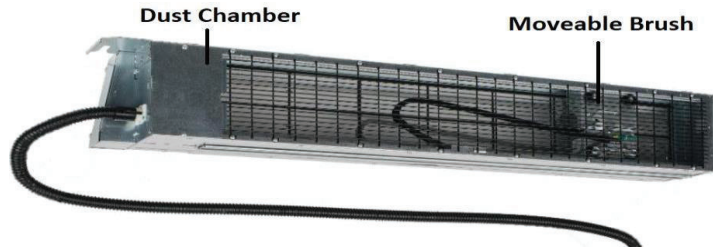


Fig 1: Self Cleaning Filter.

3. Conclusion

Using a self-cleaning filter would increase the efficiency of an air conditioning system and thus it would reduce energy consumption. Fig 2 indicates the power consumption of a 2.5kW Air conditioner with dirty filter and a clean filter over 20 days. There is approximately 15% energy saving with a clean filter all the time.

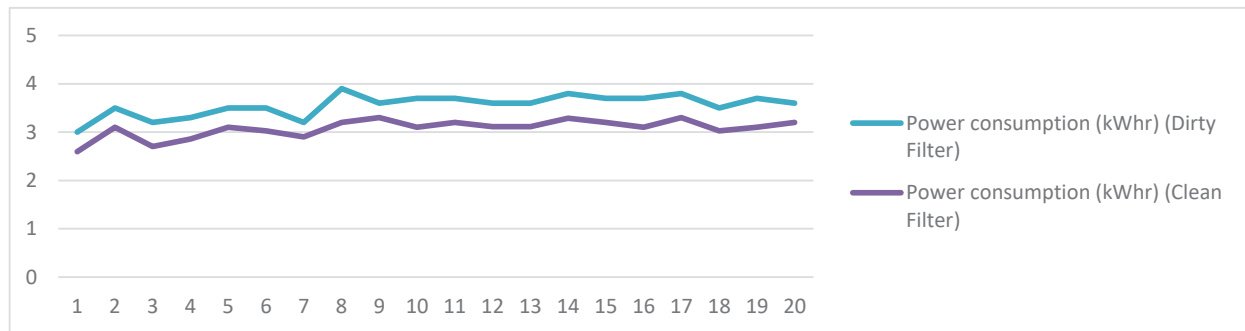


Fig 2: Comparison between power consumption with a dirty and a clean filter (each is operating for 8 hours a day for 20 days).

Air filtration is an important part in air conditioning and ideas to reduce energy consumption should be considered. As our fossil energy is limited and world's temperature is rising, air conditioners are more common now. With energy efficient devices like self- cleaning filter, would reduce the energy conversion and increase efficiency of air conditioner.

4. Reference

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