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CLASSIFICATION OF AIR CLEANING FILTERS

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Abstract

This article provides information on the classification of air cleaning filters. Requirements for air cleaning systems have been considered. At the same time, recommendations were given on improving the air cleaning system of heavy trucks operating in harsh natural conditions, i.e. in quarry conditions.

Introduction

The main requirement for air cleaning systems is that the pneumatic resistance of these systems is as low as possible, which is necessary to reduce energy consumption for gas exchange and increase cylinder filling. The system should be compact in design (small overall dimensions) and have low mass, for this it is combined with an input noise canceling element. In this, special attention is paid to the selection of dimensions and geometric shapes of the elements of the air cleaner and intake silencer, which allows to use the non-stationary phenomenon of the new charge flow to improve the filling of the cylinder.

Research object. Air filter.

Research subject. Air filter cleaning technology.

Research topic: Improvement of air filter cleaning technology.

The purpose of the study. By analyzing the existing air filter cleaning technologies, improving the air cleaning filter cleaning technology.

Research task. Studying the level of pollution during the operation of air filters. Development of cleaning technology based on these data.

Trucks use exhausts air intake systems with cleaner elements. Truck air intakes are often placed on top of the cabin or installed together with the front column frame, which allows air intake from a low dust circle from a height of 2...2.5 m. In passenger cars, the air is taken from under the car hood. The location of the air intake is determined experimentally. Air purifiers, depending on the dust content, depending on the operating conditions and various factors, the condition of the filters covered with dust is presented in (Fig. 1).

A B

1. Fig. Dust coating of air cleaning filters of quarry trucks

A) New filter B) Filter full of dust

Air pollution depends on many factors: season, soil and road type (Table 1), air humidity, speed of movement, type of vehicle and tire design, wind direction, aerodynamics of the vehicle. During the use of the car, the dustiness of the air entering the air intake in the air cleaner system of the engine depends on the location of the air intake, the speed of the car, in addition to the above, from 0.0003 to 1.4 g/m^3 may change in the interim.

Table 1

Highway type	Dustiness of the air during car movement, g/m^3	
	alone	in the column
Highway	**0,001...0,002**	-
Hard asphalt concrete coating	**0,004...0,005**	**0,015...0,020**
Non-solid	**0,01...0,10**	**0,4...0,6**
Career	**0,5... 1,0**	**2,0 gacha**

The dustiness of the air entering the air intake of the cleaner body is largely determined by the height of its location above the road surface. If the height of the air intake is increased by 0.7 m, the dustiness of the air decreases by almost 8 times, mainly due to the decrease in the amount of large dust particles.

Table 1

Tested height, m	Amount of dust, %	
	light car	truck
0,5	0,20	0,50
1,0	0,14	0,35
1,5	0,04	0,22
2,0	0,01	0,14

One of the main characteristics of an air purifier that affects its performance is dust dispersion. According to the composition of the dust, it is divided into three types:

1. Particle size greater than 150 μm and a settling velocity of 1.0 m/s in still air is particulate matter that rises from the road strip during the movement of vehicles. Such particles make up about 55% of the mass of the dust raised by the machine.
2. Temporary dust with a particle size of 2...150 μm and a settling velocity (1.0...0.18) of 10^{-3} m/s. The mass of dust in this form is 47...90% of the dust raised by the car, it depends on the type of soil or road surface.
3. Persistent dust consisting of particles with a settling velocity of less than 0.18-10^{-3} m/s. Quartz dust is considered more dangerous for the engine; the hardness of its particles is higher than the hardness of the friction surfaces of the engine. In addition to the road strip, solid minerals that are part of the road strip materials, as well as particles from the soot and tire wear also participate in the dust.

Quartz dust is considered more dangerous for the engine, the hardness of its particles is higher than the hardness of the rubbing surfaces of the engine. In addition to the road belt, hard minerals that are part of the road belt materials, as well as particles from the soot and tire wear also take part in the dust. The efficiency of the internal combustion engines air purifier is evaluated by the following indicators:

Air cleaning coefficient; hydraulic resistance; dust capacity; reliability; mass and overall dimensions; in the course of use, with the cost of servicing it and the cost of its construction.

Air dedusting efficiency cleaning η or dust transfer ε is estimated by the coefficients. The overall cleaning coefficient characterizes the relative amount of dust retained by the air cleaner in percentages and is determined as follows:

$$\eta=M_2/M_1 \cdot 100\% = M_1-M_3/M_1 \cdot 100$$

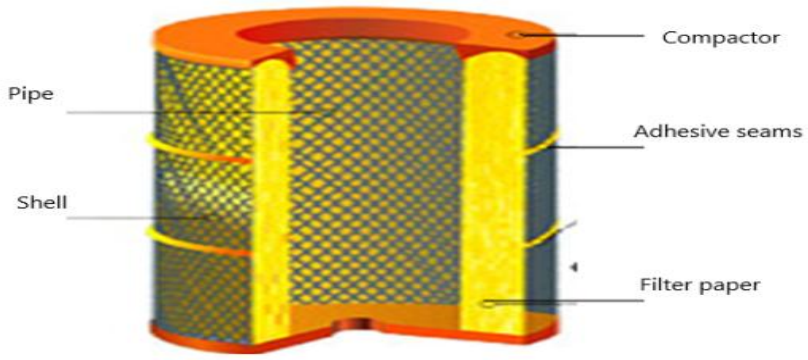
In this: M_1,. M_2, M_3 - the mass of dust that enters the air cleaner, is captured and passed by it. The dust removal coefficient is defined as the relative amount of dust behind the air cleaner: $(M_3/M_1)100\%$ The removal and cleaning coefficients are related by $\varepsilon = (100- \eta)\%$.

The air cleaning system significantly increases the hydraulic resistance of the intake system. The hydraulic resistance of the air cleaner Δp depends on its design and is defined as the difference between the pressure at the inlet to the air intake and the pressure after the last element of the air cleaner (multi-stage cleaners).

Design and operation of air cleaning systems. The following air cleaners are used in modern tractor engines: inertial-centrifugal, porous and complex. Inertial-centrifugal cleaners are used in air cleaners of tractor engines as the first stage of cleaning. The dust removal coefficient of such cleaners varies from 10 to 60%, and the hydraulic resistance does not exceed 100 mm of water column. Such indicators allow to use mainly as the first stage of cleaning. The main task of the first stage of air cleaning is to reduce the dust load of the second main stage of air cleaning, that is, to increase the duration of its operation before maintenance. In trucks, two-stage air cleaners with a cardboard cleaning element in the second stage of cleaning are common (Fig. 2).

Combined air cleaners with a cardboard cleaning element are also used, the first stage of which uses a set of cyclones that collect the separated dust in a hopper and automatically eject it with the help of a gas ejector. All-wheel drive trucks use a combined air cleaning system, the first stage of which uses conical inversion grills that automatically remove dust separated by a gas ejector. Wide use of cyclones in air cleaning systems is hindered by their size and high metal capacity.

To ensure long service life of the two-stage air cleaner, the dust transmission coefficient of the first stage ε1 should be in the range of 8... 15%



2. Fig. The structure of the air cleaning filter of trucks

The further reduction of the ε_1 coefficient does not lead to an increase in the service life of the cleaning element: cardboard two-stage air cleaner due to the sharp decrease in the specific capacity of the cleaning cardboard due to the decrease in the number of dust particles falling on the cleaning cardboard.

In addition, due to the high resistance of the first stage, the resource of the air cleaner is reduced to the limit resistance.

Summary

Turbocharged diesel engines have more stringent requirements for air cleaning. This is due to the specific characteristics of their activity. Thus, for diesel engines and turbine cars, the air filter replacement period should be reduced - at least 10-12,000 km.

References

1. Кузнецов Е.С. Техническая эксплуатация автомобилей. - М.: Наука, 2001.-378 с.
2. Lalit Kumar Sahoo, Santanu Bandyopadhyay, RanganBanerjee. Benchmarking energy consumption for dump trucks in mines.// Applied Energy, Volume 113, January 2014, Pages 1382-1396
3. Базаров Б.И. Проблемы использования в Узбекистане альтернативных моторных топлив и системы питания // Узбекский журнал нефти и газа. – Ташкент: Национальная холдинговая компания «Узбекнефтегаз», 2007. – № 2. – С. 41-42.
4. Базаров Б.И. Работа поршневых двигателей на альтернативных видах топлива. – Ташкент: ТАДИ, 2001. –138 с
5. Базаров Б.И. Энергоэкологическая эффективность альтернативных моторных топлив.// Автомобильная промышленность, 2006, №6,-с. 20-22
6. Базаров Б.И., Магдиев Ш.П. О сроках замены моторных масел АТС в горных условиях.// Автомобильная промышленность, 2011, №11, с.23-24
7. Базаров Б.И., Магдиев Ш.П. Метод оценки энергосберегающего свойства исследуемых масел.// Вестник ТАДИ, 2011, №2, с.58-61
8. Базаров Б.И., Калауов С.А. Эксплуатация и испытания двигателей внутреннего сгорания. – Ташкент: Voris – Nashriyot, 2014. – 272с.
9. Базаров Б.И., Калауов С.А.,Усманов И.И. Нормирование расхода топлива-основа эффективности использования топливно-энергетических ресурсов и обеспечения экологической безопасности.// Нефть и газ, №4, 2015.–с. 63-66
10. Базаров Б.И., Усманов И.И. Экологическая безопасность эксплуатации и нормирование расхода топлива карьерных павтосамосвалов.// Экономика и социум, 2022, №2(93), с. 1-9

11. Типовые правила технической эксплуатации месторождений полезных ископаемых при разработке открытым способом, утвержденных Председатель Государственного комитета Республики Узбекистан по надзору за безопасным ведением работ в промышленности и горному надзору 11 сентября 1998 г. № 15
12. Казарез А. И. Эксплуатация карьерных автосамосвалов с электромеханической трансмиссией / А. И. Казарез, А. А. Кулешов. – М. : Недра, 1988. – 264 с.
13. Карьерный автотранспорт: состояние и перспективы / П. Л. Мариев [и др.]. – СПб. : Наука, 2004. – 429 с.
14. Зырянов И.В. Повышение эффективности систем карьерного автотранспорта в экстремальных условиях эксплуатации. Диссер… учен. степ. д.т.н. -СПб, 2006.-260 с.
15. Ахметова М.И. Комплексная оценка и способы повышения показателей качества эксплуатации карьерных автосамосвалов. Диссер…учен. степ. д.ф. (PhD).-Алматы,2019.- 133 с.
16. Антонов Ю.А. и др. Автомобильный транспорт на карьерах. Конструкции, эксплуатация, расчет.-М.: Горная книга, 2012. -408 с.
17. Мариев П. Л. и др. Карьерный автотранспорт: состояние и перспективы.-М.: Наука, 2004.-430 с.
18. Евсеев В. Н., Вареничев А.А. Автосамосвалы на карьерах.// Горный информационно-аналитический бюллетень, 2017, № 8, с.30-36.
19. Квагинидзе В. С. Эксплуатация карьерного горного и транспортного оборудования в условиях севера.-М.: Моск.Гос. горный уни-т, 2002.-236 с.
20. By Roger Thompson, Rodrigo Peroni, Alex T. Visser. Mining Haul Roads. Theory and Practice. CRC Press, 2020.- 316 p.
21. Мигаль В.Д., Мигаль В.П. Методы технической диагностики автомобилей.-М.:Форум , 2019.- 417 с.
22. Ждановский Н.С., Николаенко А.В. Надежность и долговечность автотракторных двигателей.-Л.: Колос, 1981.- 395 с.
23. Дьяков Р.А. Воздухоочистка в дизелях.- Л.: Машиностроение, 1975.- 152 с.
24. Глыбин А.И. Автотракторные фильтры. Справочник.- Л.: Машиностроение, 1980.- 181 с.
25. ГОСТ Р 53837-2010 Двигатели автомобильные ВОЗДУХООЧИСТИТЕЛИ Технические требования