

Analysis of Contaminants in Vehicle Maintenance and Repair Enterprise

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Abstract. The increase in vehicle ownership has led to an increase in the number of auto repair companies. However, people have neglected the pollution caused by auto repair companies during the maintenance process. This paper analyzes the 4S shop and a class of maintenance companies and analyzes the company's maintenance process. The pollutants produced and the pollutants produced by them were subjected to predictive analysis, and the atmospheric pollutants were found to be spray paint exhaust gas, grinding dust and welding fumes and their corresponding values. The noise source intensity was 55-65 dB(A); This article can provide a reference for the environmental impact assessment of auto repair companies.

Keywords: Automobile, Contaminants, Spray paint, Noise.

Introduction

One type of auto repair business is mainly based on 4S shops and some large-scale repair shops[1,2]. It is engaged in vehicle overhaul and assembly repairs, and may also be engaged in vehicle maintenance, minor repairs, and special repairs[3,4].

One type of automotive repair service business, including engine repair, body correction, oil supply system maintenance and oil replacement, electrical system maintenance, tire dynamic balance and repair, four-wheel alignment testing and adjustment, air conditioning maintenance, sheet metal, touch up paint, etc[5-8]. Oil, waste water, hazardous waste, exhaust gas and other pollutants will be generated. See Fig 1 Detailed process flow and the resulting pollutants in the Garage and Fig 2 Technological process and the resulting pollutants of sheet metal painting process.

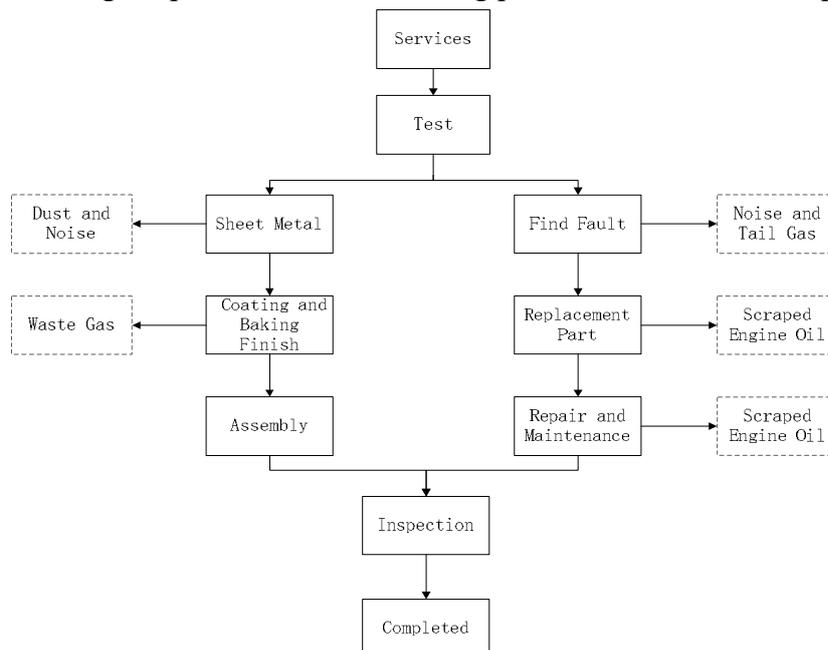


Fig 1 Process flow and resulting pollutants in the garage

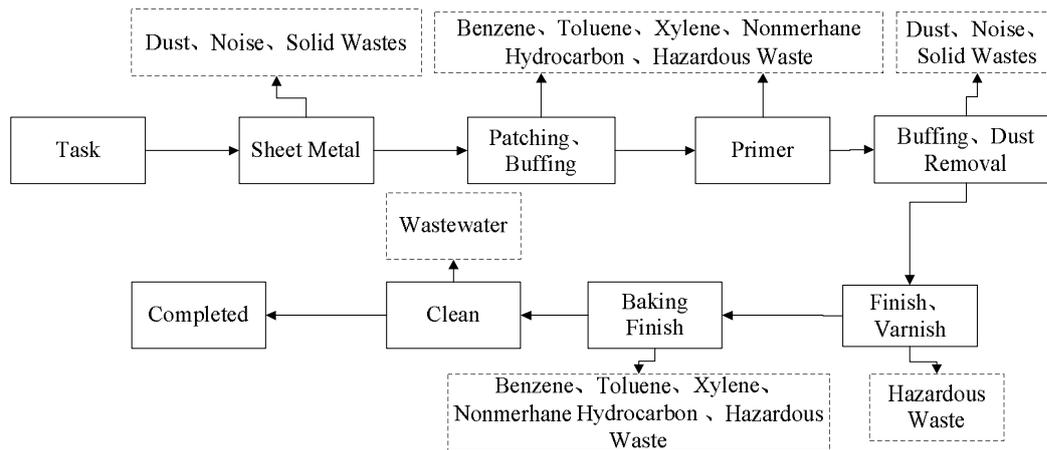


Fig 2 Technological process and resulting pollutants of sheet metal painting process

One of them sprays the vehicle, the sheet metal process and the putty, and then uses the grinding equipment to manually polish it, then uses the special paint to make up the sand, and then after grinding, it enters the spray paint booth to spray the primer, and then plays the tracheotomy gray and spray paint[9,10].

Process analysis of pollutants generated

Waste water mainly includes cleaning sites, car wash water and domestic sewage. The maintenance workshop clean effluent contains certain suspended solids, organic matter, petroleum, etc. The domestic sewage is used for hand washing and toilet flushing. The main pollution factors for sewage are COD_{cr}, BOD₅, SS, ammonia nitrogen and petroleum.

The source of atmospheric pollution is the exhaust gas generated by spray booths and the dust generated by maintenance workshops, welding fumes, and other pollutants.

Paints used in paint houses include primers, paints and varnishes. Primers and color paints are water-based paints, and varnish is a volatile paint. The main components of water-based paint are resin and water, and there are a small amount of etchers, alcohols and stones, and do not contain organic solvents such as benzene and toluene.

About 60% of the solid content is attached to the paint surface during the painting process, and the remaining 40% of the solid content is transformed into paint mist. The national regulations stipulate that the low volatile organic content paint such as water-based paint accounts for not less than 80% of the total paint usage.

After repairing the vehicle's putty, the repair workshop grinds it with a dry grinding device to generate dust containing exhaust gas in the surrounding area. The dust particle diameter is 5-10 μm, and the exhaust gas volume is smaller by about the volumes of 100 m³. However, its high concentration, concentration of about 500mg/m³-700mg/m³, the body can be breathed into the respiratory hazard.

In the welding process, the CO₂ protection welding machine will generate welding fumes. After the welding fumes are diluted in the workshop air, the concentration of welding fumes in the maintenance workshop air is low.

The noise mainly comes from spray booth exhaust fans, machine repair equipment, air compressor equipment operation noise, sheet metal operations and so on. The noise source intensity of the paint exhaust fan is about 77dB(A), the noise source strength of the machine repair equipment is about 75~80dB(A), and the noise source strength of the air compressor is about 80dB(A). The noise is mostly sudden transient noise, and the source intensity is about 85~95dB(A).

Solid waste is mainly domestic waste, general industrial solid waste, and hazardous waste. The general industrial solid waste generated during the vehicle maintenance process includes used tires, waste packaging materials, and other scrap components. The hazardous wastes are mainly waste mineral oils (gasoline, diesel oil, engine oil, lubricating oil, cotton cloth contaminated with oil, etc.),

paints, dye wastes (waste paint, waste thinners, waste paint slag, filter cotton after use in spraying booths, etc.) Activated carbon, etc.), waste organic solvents (waste organic solvents generated during the cleaning of parts, waste cleaning agents, waste antifreeze used for vehicle maintenance and replacement, etc.), and other wastes (waste paint buckets, paint cans, waste oil barrels, etc. Electronic components, circuit boards, etc.) Waste lead-acid batteries (storage batteries).

Forecast analysis

Most auto repair companies and auto 4S shops are located in urban suburbs, far away from residential areas. This paper implements Surface Water Environmental Quality Standard GB3838-2002 for surface water environmental quality standards. IV Water quality standards, environmental air quality implementation of the "Ambient Air Quality Standards" (GB3095-2012) in the secondary standards, the implementation of the "acoustic environment quality standards" (GB3096-2008) in the category 2 area standards, the resulting danger The wastes were implemented in 11 automobile 4S shops under the "Control Standards for Storage Pollution of Hazardous Wastes" (GB18597-2001), and 9 auto repair companies were surveyed and forecasting. The major pollutants produced by averaging them and their predicted discharge status are shown in the Table 1.

Table 1 The main pollutants emissions and predicted

Types of	Emission source	Contaminant name	Concentration and production	Emission concentration and emissions
atmospheric pollutant	Spray paint room	Benzene series	6.46mg/m ³ (0.15505t/a)	0.646mg/m ³ (0.0155t/a)
		Non-methane total hydrocarbons	23.29mg/m ³ (0.55895t/a)	2.329mg/m ³ (0.0559t/a)
	Repair shop	Grinding dust	600mg/m ³ 102kg/a	0.001mg/m ³ 1.02kg/a
		Welding fumes	0.013mg/m ³ (0.48kg/a)	0.013mg/m ³ (0.48kg/a)
Water pollutants	Domestic sewage, maintenance workshop clean water	COD _{cr}	290mg/L (0.0237t/a)	29mg/L (0.0024t/a)
		BOD ₅	260mg/L (0.0212t/a)	18mg/L (0.0015t/a)
		SS	140mg/L (0.0114t/a)	21mg/L (0.0017t/a)
		Ammonia nitrogen	29mg (0.0024t/a)	12mg/L (0.001t/a)
		oil	7mg/L (0.0006t/a)	1mg/L (0.0001t/a)
Solid Waste	Everyday life	Living garbage	2.14t/a	2.14t/a
	Repair shop	General solid waste	20t/a	20t/a
		Hazardous Waste	15.53t/a	15.53t/a
Noise	Repair shop	60-95dB(A)		

In order to prevent the excessive discharge of water pollutants, a type of auto repair enterprise has considered the problem of sewage discharge in the initial stage of construction. According to the "unit discharge standard for water pollutants in the automobile maintenance industry" (GB26877-2011), It is a small vehicle of 0.014 m³, the type of maintenance companies surveyed exceed this limit and have a low impact on the surrounding water environment.

According to investigations, when spray painting and paint mixing operations are performed on spray paint booths, unless exhaust gas treatment measures are taken, the exhaust gas emissions

exceed the allowable emission standards. Therefore, if no measures are taken, spray paint booths will be detrimental to the local atmospheric environment. The impact, especially for direct operators, requires the use of appropriate purifying measures for the benzene series emitted from spray paint and paint conditioning operations.

The exhaust gas generated during the operation period of spray paint booths is subjected to adsorption treatment with supporting filter materials and is discharged from the exhaust pipe with a height greater than 15m through a mechanical exhaust device. The concentration of each pollutant emitted from the exhaust gas during the operation period of the spray booth is Conforms to the "Emission Standard for Air Pollutants in the Automobile Maintenance Industry" (DB11/1228-2015).

The grinding process should be carried out in a relatively closed workshop. The dust produced is controlled by a mobile dust collector that is equipped with a dry mill. The dust removal efficiency is 99%, and the concentration of grinding dust is averaged.600mg/m³, after the purification of dust concentration 6mg/m³, maintenance workshop area of 1000m², about 7m floor height, after dilution in the maintenance shop air, grinding dust concentration of 0.001mg/m³. The amount of grinding dust produced by the maintenance workshop of the project is approximately 102kg/a. After the collection and purification treatment by the mobile dust collector, the dust emission of the grinding dust is 1.02kg/a.

After the vehicle has been putty and polish with a dry grinding device, It will generate grinding dust in the surrounding area. After being cleaned by the mobile dust collector and diluted in the workshop air, It will be discharged in an unorganized manner in the maintenance workshop. It is estimated that there will be no organization monitoring. The concentration was 0.001mg/m³.

After a small amount of welding fumes generated during the welding process was diluted in the air of the repair shop, the welding fumes were discharged unorganized with a concentration of 0.013mg/m³ and met the "Integrated Emission Standard for Air Pollutants" (DB11/501-2007).

The attenuation formula caused by the increase of noise with distance:

$$\Delta L = L_1 - L_0 = 20 \lg \left(\frac{r_1}{r_0} \right) \tag{1}$$

In the formula, L_1 、 L_0 Point-to-point sound source r_1 、 r_0 Noise value, dB(A); r_1 、 r_0 Is the distance (meters) from the noise source, r_0 Generally pointing away from the sound source 1 meter.

The superposition formula of N noise sources:

$$L = 10 \lg(10^{\frac{L_1}{10}} + 10^{\frac{L_2}{10}} + \Lambda + 10^{\frac{L_n}{10}}) \tag{2}$$

In the formula, L Total equivalent sound level, dB(A); L_0 、 L_1 、 L_n , They are the equivalent sound levels of N noise sources, dB(A).

According to the monitoring of 4S shops and a class of auto repair companies, the prediction of the surrounding ambient noise is obtained by combining the equations above.

Table 2 The surrounding ambient noise predictive value

Predicted location	East	South	West	North
Monitoring background value	62.2	53.1	52.6	52.9
Contribution	14.4	30	30	50
Predictive value	62.2	53.1	52.6	54.7

After the noise is attenuated by the sound insulation and distance of the wall, the noise at the plant boundary complies with the "Emission Standard for Environmental Noise at the Boundary of Industrial Enterprises" (GB12348-2008).

Solid waste is recycled by a specialized material recovery unit. Domestic garbage is removed by the municipal sanitation department. It is cleared daily and no secondary pollution occurs.

Conclusion

The main atmospheric pollutants of a type of maintenance enterprise are spray paint exhaust gas, grinding dust and welding fume, spray paint exhaust gases such as toluene, xylene and non-methane total hydrocarbon produced during the spray paint process. After filtration and adsorption treatment of the filter material supporting the spray paint room, it is discharged through the exhaust pipe with a height of 15m or more. At the same time, the operator needs to do a good job of protection.

The intensity of the noise generated during the maintenance process is about 60-80dB(A), and the short-term noise source intensity generated by the sheet metal process is about 70-90dB(A). After the sound insulation of the building and the distance attenuation, the noise source Strong can be reduced to 55-65dB(A). It is recommended that 4S stores and one type of maintenance enterprise should be located away from residential areas and college hospitals.

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