

The Working Principles of a Simplified Tail Gas Purge System

REN Wei YANG Run-xiu HUANG Hong-jin LIU Xie-quan

(Department of Basic Courses Ordance Engineering College, Shijiazhuang 050003, China)

Abstract Automobiles as a popular means of transportation in the modern Age bring great convenience to the human life but also great pollution as well giving off tail gas and polluting the air. This thesis introduces a simplified tail gas purge system which functions to absorb the harmful elements in tail gas.

Key words tail gas service equipment recycle depoly purge

CLC number X51 **Document code** A **Article ID** 0529-6579 (2007) S1-0027-02

With the popularization of autos in Chinese metropolises the environmental pollution there is no longer rooted in industrial pollution as it was in the early years but in tail gas pollutants. Take Shijiazhuang, the capital of Hebei Province as an example. A survey done on the tail gas pollution there indicates that the motor vehicle as many as 130 000 now and increasing by 15% annually gives off 4.4 ton of carbon monoxide 46 times of that from industrial enterprises.

Due to the high divertedness and mobility of cars, purge processing techniques can only be used in limitation. There are two ways to do this: (1) the control techniques including uplifting the combustion of fuel and developing new engine types; (2) management discarding the old types using better fuel and developing new types of autos (those without harmful tail gas). At present people usually take two measures:

① improving the fuel quality by mixing oxygen organic in petrol. It is reported that the pollution caused by CO, NO_x, HC and lead dust can be greatly decreased or eliminated by mixing 15% of methanol or 10% of water in petrol. When using methanol fuel with 30% ~ 40% of methanol in petrol, the pollutants in tail gas can be almost cleared off. 200 000 tons of ethanol mixed into petrol at the proportion of 1:9 can produce 2 000 000 tons of ethanol petrol which can help reduce the carbon monoxide in tail gas by one third, the hydrocarbon by 13.4%. But this method is not yet popular owing to the high investment. ② Outside engine purging of the gas released which makes the harmful tail gas harmless before sending it off into the air. To do this we have to with the help of highly ef-

fective catalyst oxidize CO into CO₂, HC into CO₂ and H₂O and then reduce NO_x into N₂^[1]. They can purge CO and HC effectively. But the problem with them is their high price and short life.

1 Design of the Apparatus

Comparing the various designs available at present, this paper presents a simplified tail gas purge system employing simple chemical reactions to reduce the harm from tail gas.

It is known that the main elements of tail gas are CO, NO_x and HC as well as particles from burning in between. This system, with the high temperature air radiated from the engine together with the oxygen pumped in from outside, oxidizes well enough the main elements in tail gas and changes CO_x and NO_x into CO₂ and NO₂ respectively, and then absorb NO₂ and CO₂ with NaOH water mixture. As 1/3 amount of NO will be produced during the NO₂ reactions, the service equipment (the signal transmitter) can control it from getting back into the oxidizing and absorbing apparatus. In this way, this system reduces the pollutants in tail gas to its minimum^[2].

The whole set of apparatus includes 4 parts: ① Electrostatic Precipitation Apparatus; ② High-Temperature Oxidation Apparatus; ③ Absorbing Apparatus; ④ Cycle Control Apparatus.

2 Working principles and functions of each part

The whole set of apparatus includes 4 parts:

①收稿日期: 2007-01-10

基金项目: 石家庄军械工程学院科技创新资助项目

作者简介: 任伟 (1987年生), 男, 本科生; 通讯联系人: 刘协权, E-mail: kqxh@163.com

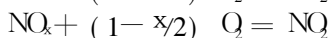
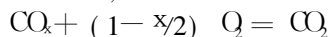
2.1 Electrostatic Precipitation Apparatus

Make the auto power add electrical pressure to the electrode plate letting the mixture air through in between, and we can get the dust particles in the mixture air attracted and attached to the positive and negative plate (P-N plate for short). To be exact, we use shielded double-layer soft transverse to output the auto power to the positive and negative plate and connect the switch of the system to the auto power so that as soon as the auto starts the purge system also starts to work.

2.2 High temperature oxidation Apparatus

This unit heats and oxidizes the mixed air of CO , NO_x and H_2 , turning it into NO_2 and CO_2 . This bottle of iron has two stories inside with a total capacity of 2.5 L, from one end of which lots of oxygen can be

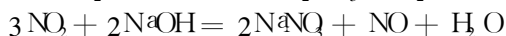
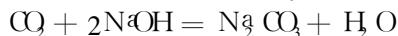
blasted in. Successively, this oxygen goes through the needle shaped small holes, reach the inner surface of the bottle rapidly and mix sufficiently with the gas mixture there. Along the two sides of this apparatus are the oxygen conduit pipe and the pressure-giving pipe. The reaction principles



2.3 Absorbing Apparatus

This part using a U-Pipe delivers the gas mixture output from the oxidation structure into a cylinder container which contains NaOH solution. After sufficient reactions, the salt resultant precipitates onto the bottom of the bottle while the unreacted air including the surplus NO and CO_2 flows out through a pipe. At the bottom of the apparatus there is a layer of net-shaped nickel which keeps the salt resultant and also contributes to catalyze and accelerates the chemical reaction.

The reaction equation goes like



2.4 Cycle Control Apparatus

When the unreacted gas mixture flows out of the pipe and into the service equipment^[1], the engine will turn the NO_2 density signal into electrical signal and the NO_2 Density level turns into the number readings on the engine panel. A valve is set just at the connection of the service engine and the pipe which will open automatically and send the purged air into the atmosphere when the NO_2 density is within the required degree; otherwise, the valve will be shut tight keeping the unpurged air back to the solution in the gas cycling device for more reactions^[2]. This gas cycling device operates in the similar ways as liquid cycling device, employing the pressure difference to deliver the rest of the tail gas to the solution bottle for further reactions. Again and again, the rest of the tail gas will be sent back to the solution bottle until its density reaches the required criteria. According to the reaction equation, the nitride oxide in tail gas will reduce by one third so that. After repeated circulations, the harmful elements in tail gas is sure to reduce to a great extent.

3 Conclusion

This system is characterized as simple, convenient, cheap but durable. The feasible design makes it highly effective in purifying tail gas and even produces recovered acid as a side product useful in industry.

References

- [1] JI Li-jun, YING Wei-yong, ZHU Jia-wen. Performance of Y-TYPE Airblast Nozzle in Solvent Removing Process of Chlorination Liquid[J]. Journal of East China University of Science and Technology (Natural Science Edition), 2006, 32 (12): 1388—1391.
- [2] SIERN Fred, WILSON R V. Comprehensive Approach to Verification[J]. Transactions of Beijing Institute of Technology, 2001, 123 (2): 135—142.

一套简易尾气净化系统的研制

任 伟, 杨润秀, 黄红军, 刘协权

(石家庄军械工程学院基础课程系, 河北石家庄 050003)

摘 要: 汽车作为现代化交通工具, 给人们的生产与生活带来方便的同时, 它的尾气排放物, 也给大气环境造成严重污染。介绍了一套简易尾气净化系统, 它可以吸收汽车尾气中的有害成分, 并且能循环使用而且节能。

关键词: 尾气; 伺服转化装置; 循环使用; 净化

中图分类号: X51