

Design, Development and Evaluation of CNG Fuel System for Using in Diesel Engine of Tractor

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ABSTRACT: Today using fossil fuels such as gasoline and petrol in order to apply in gasoline and petrol engines have faced with serious challenges such as high costs of servicing, fixing, storing, and lacking of safety. Therefore finding suitable substances can help to solve these problems in industry and energy sections. In this essay, system of compressed natural gas fueling is used in the tractor diesel. So that, the physical structure of it is based on lowest changes in general mechanism of engine and lowest used amount of electronic and mechanical equipment and parts. The results show that the designed system is able to answer the engine needs and to reduce pollution rates.

Keywords: Tank-Regulator-Manifold-Mixer-CNG.

INTRODUCTION

In the paper, compressed natural gas (CNG) is used in the diesel engines. And, aims of usages of them such as being economy, increasing efficiency of fuel, reducing pollution, increasing safety, and economic justification. So if we want use them in cars, we should compress them and change to liquid. Therefore this fuel is called compressed natural gas (CNG).

Today all agricultural machineries especially tractors use diesel fuel. The compressed natural gas is suitable substance for diesel fuel. According to Fischer and others, natural gas compared with gasoline can produce more power per each kilogram. In the other hand, each one kilogram of natural gas needs more oxygen in the combustion process. This is important in related to engine power of the CNG engine.

Goals of Research

- Reducing fuel consumption and using compressed natural gas (CNG) in tractor diesel engines;
- Reducing pollution and other pollutants such CO-NOX-PM-HC that they are harmful to human being health;
- Reducing engine sound (Combustion pressure in the CNG engines is lower than other fuels.) and improving engine performance;
- Increasing safety of tractor diesel engines if they use CNG system; and
- Reducing costs of servicing, fixing, and storing of CNG tractors.

MATERIALS AND METHODS

In the research, a six-cylinder Massey Ferguson tractor 399 is used for CNG project. In this way, gasoline fuel uses as firing product and gas fuel uses as main fuel. Also due to designing and making compressed natural gas

system is used in tractor diesel engines, we use combined fuel that involves changes in air manifold and using a mixer and a gas valve among air inlet channel into combustion shield.

Figure 1 shows that in the action cycle of mentioned system, fuel reaches from tank to regulator with pressure of 200 times. After reducing pressure by the regulator the fuel moves towards mixer with pressure of 1.8 times, then it after mixing by air manifold enter combustion shield.

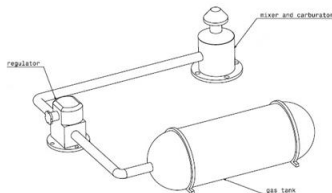


Figure 1. the action cycle and elements of the system

Gas Tank of CNG

Gas tank of CNG is used for storing car consummated gas. In the paper, like figure 2, the tank installs in back of the tractor seat. The tank involves a tank with capacity 4 kilos.



Figure 2. the used tank

The other used elements in this paper involve regulator, eclectic tap of regulator, mixer, gas valve, and manometer.



Figure 3. the elements of system

RESULTS AND DISCUSSION

In the research, after designing gas system of CNG, in order to determine pollution rates of CO, O₂, HC, and CO₂ on the engine, some tests are done. It shows that pollutants in the CNG system are lower than the gasoline system significantly. In below figures, the engine cycle in 4 statuses (situ, sudden, gradual, and pollution levels) is showed.

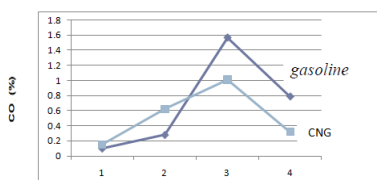


Figure 4. the test of pollution CO in two phases CNG and gasoline in different statuses

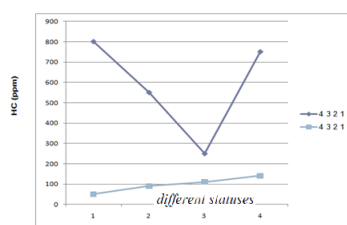


Figure 5. the test of pollution HC in two phases CNG and gasoline in different statuses

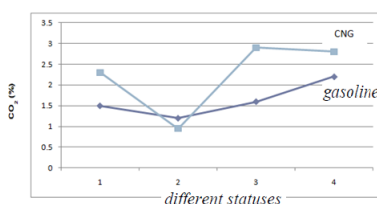


Figure 6. the test of pollution CO₂ in two phases CNG and gasoline in different statuses

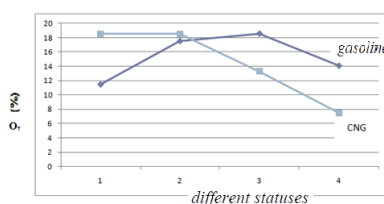


Figure 7. the test of pollution O₂ in two phases CNG and gasoline in different statuses

Discussion

Using CNG fuel does not show significant change in power practically when the engine works.

The key result in the paper is that with occurring minimum changes in engine mechanism, the engine transforms bi-fuel engine and no changes in cylinder head, cylinder, piston, etc are observed. And, that is, the action is economy. The next result of the paper is that in loading time of CNG amounts of HC, CO, and NO₂ compared with the gasoline phase is reduced and CO₂ is increased.

Proposals for Future Researches

Regard to all problems and challenges in the research process and regard to this notion that best way in making bi-fueling of gasoline vehicles is combined fuel with low costs and investments; so we suggests manufactures companies in order to reduce of their own costs and upgrade this research as possible, they should try to give agriculturist and industries most rapid, comfort ways and remove some of challenges exist in energy and fossil fuels.

With attention to this problem that pollution is most important danger that threatens future of environment, and also in order to employ and update bi-fuel technology of diesel vehicle, we suggest in order to schedule fuel they use a unit of electronic control instead of gas valve and mixer. Also, in order to manage gas fueling toward the combustion shield usefully they employ a rail of gas fuel.

We suggest in order to have enough space in installing the CNG tank tractor manufactures plan a suitable place. As an idea, this place can be under the splash guard of back wheels. This action can provide a space that help both energy and environment.

Using compressed natural gas in the vehicles with fuel cells (if industry of vehicles using fuel cells develops) is necessary.

We suggest using injector pump type liner instead of injector pump type Asian in future tractors. Servicing, repairing, storing the liner injector pumps is easy, and, when the engine work in gas phase, regulation all thermodynamic parameters is easier.

Tractor belongs to desert vehicles and the dust may cause difficulties in gas equipments, so it is better to study gas equipments resistant against dust.

In order to increase quality of compressed natural gas fuel on the diesel vehicles, we suggest manufactures study more on the strength of diesel engine equipments and produce pieces compatible with gasoline and natural gas fuels.

More study on better ways of processing natural gas fuel for increasing number of methane in order of increase of quality of this fuel for using them in tractor diesel engines is suggested, too.

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