THE OPERATION OF CNG-DRIVEN WASTE DISPOSAL VEHICLE

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Abstract: *At the present the crude oil is the most widely used source for fuel production. People are starting to think about its compensation other ecological fuel that will be economically preferable and at the same time when it will be burned, the less emission of CO2 will escape into the atmosphere. The compressed natural gas can meet requirements mentioned above. Therefore interest in natural gas is still growing. This fuel has become interest in finding ways to reduce greenhouse gas and smog-forming. The paper is aimed at the operation evaluation of CNG-driven vehicle. We observed the parameters of municipal vehicle Mercedes – Benz Econic which was operated in a Slovak Republic. We evaluate fuel consumption during the year 2011. We conclude that the operation of CNG-driven vehicle is economic and ecologic. We also conclude that CNG waste disposal vehicle can be a good deal in reducing crude oil use and emissions*

Keywords: NATURAL GAS, MUNICIPAL VEHICLES, THE FUEL CONSUMPTION, ALTERNATIVE FUELS

1. Introduction

At the present the CNG fuel is popularity, from view of its clean-burning properties. Vehicles which using compressed natural gas (CNG) generate fewer exhaust and greenhouse gas emissions than their gasoline- or diesel-powered counterparts. Natural gas is one of the most widely used forms of energy today. It is commonly used to heat homes and businesses nationwide. CNG vehicles store natural gas in high-pressure fuel cylinders. An odorant is normally added to CNG for safety reasons.

There are two types of vehicles on the market. The first one operates only on natural gas. The second one uses dual-fuel (natural gas and gasoline or diesel). CNG vehicles include trucks, vans, buses and public service cars. EPA (2002) say that the emission reduction of compressed natural gas relative to conventional fuel means reduction in carbon monoxide emission of 90 to 97 percent, reduction in carbon dioxide emission of 25 percent, reduction in nonmethane hydrocarbon emission of 50 to 75 percent, fewer toxic and carcinogenic pollutants, no evaporative emissions in dedicated engines (such as those associated with gasoline or diesel).

Compressed natural gas costs less than conventional fuel as gasoline or diesel. CNG contains less energy by volume compare with conventional fuels. Therefore, CNG-powered vehicle has to be more often refuelling. This vehicles cost more then diesel or gasoline-powered vehicles.

In comparison with diesel driven vehicles, CNG vehicles have higher fuel consumption. Normally, however, one litre of diesel can be replaced by approximately one cubic metre of gas. Natural gas can be stored onboard a vehicle as compressed natural gas.

Under the current level of European emission standards EURO diesel cars are 'legally' allowed to emit more NOx than the comparable petrol cars and also several times more particulates. Petrol vehicles have negligible emissions of particulates, while every diesel car is allowed to emit 0.05 gm/km in the Euro III norms. Petrol vehicles on the other hand are given higher limit for CO, as compared to diesel. Roychowdhury (2010) say that one diesel car is equal to adding 7.5 petrol cars to the car fleet in terms of PM emissions and 3 petrol cars in terms of NOx emissions. This clearly reflects the flawed emission standards that allow diesel cars to emit more NOx and PM compared to petrol cars. Total air toxics from a diesel car that are very harmful and carcinogenic are 7 times higher than petrol cars.

New CNG technologies promise significant reduction in PM, and NOx emissions as well as improve fuel efficiency. In fact CNG technology demonstrates one of the cleanest emissions levels ever in the US and Europe and achieve lower emissions levels as Euro 5 norm.

2. Materials and Methods

Technology for CNG engines is fully developed and field-tested. Expenses for engine management and exhaust gas treatment are about the same as with traditional drive-trains, operation is economical thanks to low fuel costs. This makes CNG drive a cost-effective contribution to cleaner mobility, which is becoming ever more important specifically in cities. There are two types of CNG vehicles: Monovalent vehicles, which run exclusively on CNG, are mainly used for inner-city applications. Dual-fuel systems allow engine changeover for combined diesel and CNG operation. They can also be operated on routes without CNG infrastructure (Bosch, 2010).

The Mercedes Econic Rotopres is the special-purpose vehicle for the municipal sector, consolidated freight and short-radius distribution. This car use CNG fuel. The area of application is the waste-disposal sector. The Econic's lightweight aluminium space cage structure is available in two variants: the high-roof and low-roof cab. Thanks to the low-floor concept (low access height, level cab floor and low frame), effective, safe and energy-saving work processes begin the moment you get into the Econic (Mercedes Benz, 2012).

Fig. 1 *Mercedes Econic Rotopress*

Fig. 2 *Mercedes Econic Variopress*

The Mercedes Axor Rotopress was designed specifically for these tasks, so high payload is one of its fortes. It is already a very efficient vehicle with a durable, economical and powerful 6-cylinder engine plus a special powertrain configuration. This vehicle disposes of robust design, long service intervals and reduced the weight.

Fig. 3 *Mercedes Axor Rotopress*

We calculate the CNG fuel consumption according to formula (1):

$$c_{CNG} = \frac{w_{CNG}}{d} \quad (1)$$

Where: c_{CNG} – consumption of CNG, kg/km

w_{CNG} – weight of used CNG, kg

d – *distance, km*

3. Results

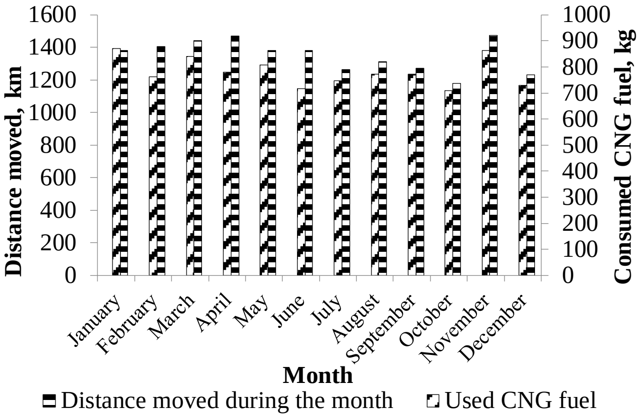

Fig. 4 *Operation of CNG-driven vehicle Mercedes Econic Rotopress during the year 2011*

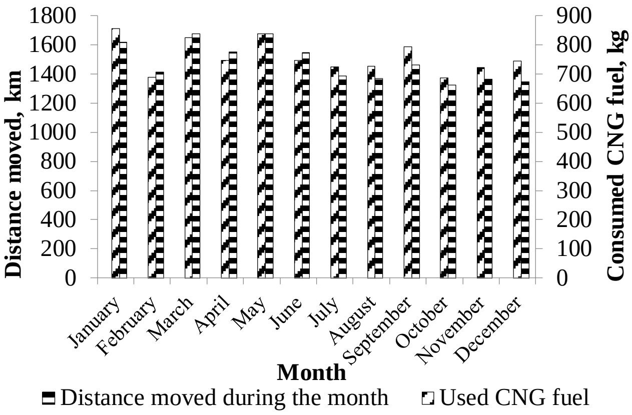

Fig. 5 *Operation of CNG-driven vehicle Mercedes Econic Variopress during the year 20111*

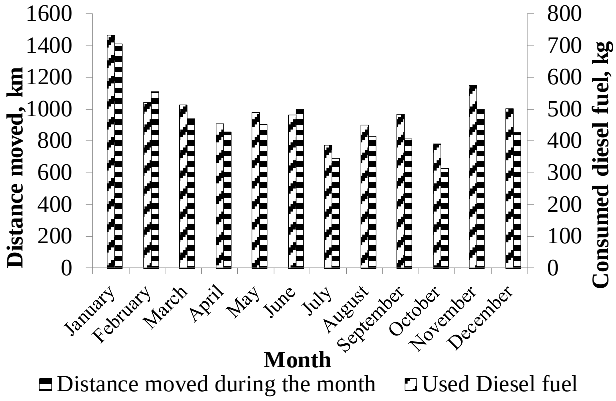

Fig.6 *Operation of diesel-driven vehicle Mercedes Axor Rotopress during the year 2011*

4. Conclusions

The operation of CNG-driven vehicles was observed in the public service company in city Žiar nad Hronom which is localised in Slovak Republic. We observed the vehicle operation during one year 2011 on the basis of moved distance and consumed fuels. The CNG-driven vehicles have a better consumption than diesel-driven vehicles, fig. RRR, fig. JJJ, fig. TTT. In case of CNG-driven vehicles Rotopress we calculate average consumption 57.99 kg / 100km and Variopress 51.39 kg / 100km. Diesel driven vehicle has consumption 54.82 l / 100 km.

CNG-powered vehicle Mercedes Econic Rotopres cost between €60,000 to €70,000 more than diesel-powered vehicle Mercedes Axor Rotopres. Both vehicles mentioned above have the same power and operating parameters. The Slovak Republic has only few CNG refueling stations. As a result, CNG is currently available at only 11 refueling stations but this number continues to grow. This fact is the main disadvantage for use CNG-driven vehicles in Slovak Republic.

The component of lifecycle costs that has received the most attention recently is the fuel cost. CNG fuel price are more stable than gasoline and diesel fuel prices. For example, the fuel costs of using natural gas instead of diesel can be one-third lower.

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