

MOST WIDESPREAD TRUCK FUEL SYSTEMS IN LATVIA

Janis Mistris, Gints Birzietis
Latvia University of Agriculture
janis.mistris@llu.lv, gints.birzietis@llu.lv

Abstract. According to a respective European Directive, it is now very important to use biofuels in transport as much as possible. Despite that, many studies on the use of biofuels in vehicles are done; the general increase in the share of biofuels in total fuel consumption is mostly achieved by compulsory admixture of biofuel to fossil fuel. In order to perform further studies on the use of biofuels in the existing vehicle fleet in Latvia, it is necessary to define the more widespread vehicle fuel system. In previous studies, the most widespread car fuel systems in Latvia were identified. Overall, 91588 trucks are registered in Latvia as per 01 January 2010, and only 51431 of them are suitable for road traffic. Some trucks of specific brand and model year are more popular and widespread in Latvia than others, and many trucks at the same time have similar or same fuel systems. The objective of this study is to determine the most widespread engine fuel systems for trucks in Latvia. The study is based on the analysis of the Road Traffic Safety Authority data, specific truck model manuals and information provided by car dealers.

Keywords: fuel systems, most widespread fuel supply systems.

Introduction

In vehicles, the engines of which consume petrol as fuel, a carburettor was designed for the first of fuel systems. From its first prototype, nowadays it became a complicated unit of the engine. As next ones, mechanical fuel supply systems were introduced in vehicles, the engine of which uses petrol as fuel. Several modifications of these systems were developed. An imperfection of the mentioned systems is that they operate independently from the ignition system. Nowadays, both these systems are integrated, and electronic fuel systems are developed in which the fuel supply and ignition are controlled by a single electronic control unit. Such systems are popular, and it is forecasted that they will be used in the nearest future for engines that run on petrol.

Several types of fuel supply systems are also developed for engines running on diesel fuel. As the first system, a multi-section high pressure fuel pump was developed in which fuel is supplied by an individual plunger to each cylinder at high pressure. Fuel is delivered to a nozzle of the cylinder through an individual high pressure pipeline for each cylinder. In earlier years, such systems were popular on cars, but today they are installed on trucks, ships, agricultural machinery, and stationary engines. As the next fuel supply system, a single plunger high pressure fuel pump was developed. Only one plunger is used in such a high pressure fuel pump that delivers fuel to all cylinders. Such systems are widespread on cars. Today such fuel supply systems as Unit Injector and Common Rail are very popular for engines running on diesel fuel. In the unit-injector fuel supply system, each cylinder of the engine is equipped with an individual high pressure fuel pump. In the common-rail fuel supply system, fuel is delivered to the nozzles of the cylinders through a single fuel pipeline.

Nowadays, electronics plays a more and more important role in automobiles. It is exploited already for a long time to ensure the operation of the fuel supply systems, but it still continues to evolve. More complicated systems and computer programs will allow use of new kinds of fuel in the future which were once regarded as inefficient.

Materials and methods

To carry out the study, available information on trucks registered in Latvia is used. Such information can be obtained at the Road Traffic Safety Authority (RTSA) [1; 2].

An algorithm for processing the data gained is shown in Fig. 1. Information of trucks in operational condition available in the RTSA database is grouped by the make of the car.

To determine the widespread fuel supply systems the auto repair catalog *AUTODATA* was used [3].

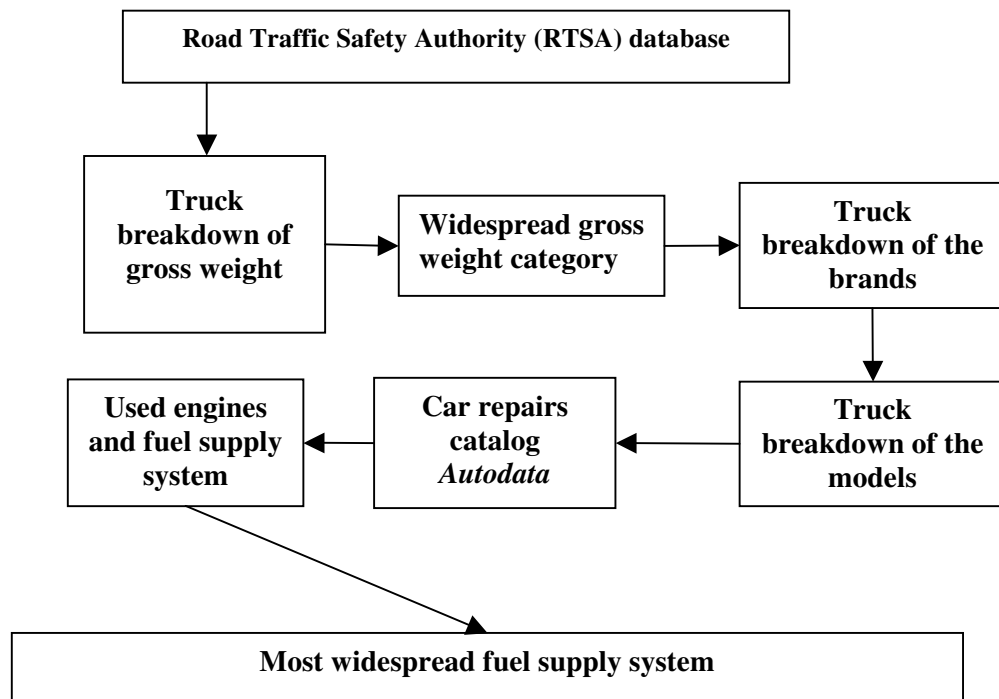


Fig. 1. Data processing algorithm

Results and discussion

In Table 1, all trucks in running order that are produced in 1985 and older are grouped. Table 1 shows that the most popular fuel for trucks is diesel fuel. Only in the group of automobiles with a gross weight from 7501 to 12000 kg, the numbers of automobiles running on petrol and diesel fuel are almost equal. Compared to the number of diesel engine automobiles, the number of petrol engine automobiles can be considered insignificant, therefore, these automobiles will not be used further in the study and only diesel engine automobiles will be analysed.

Table 1

Distribution of trucks in running order by gross weight and fuel used for their engines as of 1 January 2010

Fuel	Gross weight of trucks, kg				
	<3500	3501-7500	7501-12000	12000-16000	>16001
petrol&gas	2814	532	1102	1	1
gas	9	2	5	0	0
diesel fuel	25956	3341	1393	1089	15186
Total	28779	3875	2500	1090	15187

The largest number of trucks is in the weight groups less than 3500 kg and more than 16000 kg. These two categories of trucks will be analysed in detail further in this study, and the most popular automobile and fuel supply system for each category will be ascertained.

Fig. 2 presents the distribution of trucks in running order with a gross weight less than 3500 kg by year of production.

Figure shows that the smallest number of automobiles in this weight category was for automobiles produced in 1985. With decrease in their age, the numbers of automobiles increase for the next years of their production. The most essential increase in their number starts with 1991. Of the total number of automobiles of this weight category that are not older than 1985, 61 % are automobiles produced in 2000 or later.

The distribution of the trucks with a gross weight more than 16000 kg by year of production is presented in Fig. 3.

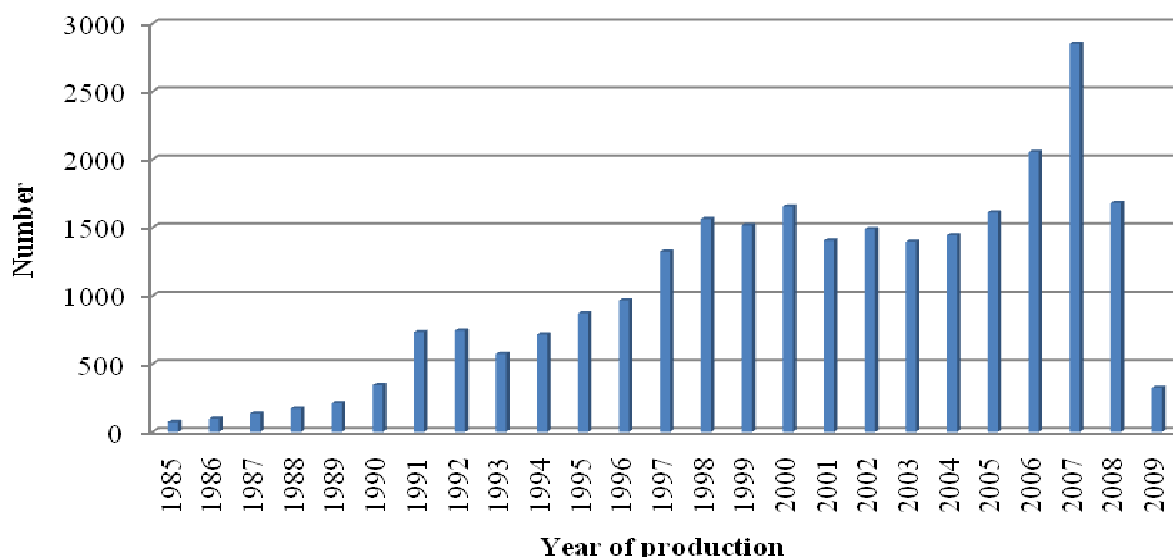


Fig. 2. Distribution of most popular trucks in running order, engine of which uses diesel fuel, with gross weight less than 3500 kg by year of production as of 1 January 2010

The number of trucks with a gross weight of more than 16000 kg that were produced from 1985 to 1997 tends to increase. Automobiles produced in 1993 are an exception; their number is smaller than the number of automobiles produced in the previous year. There are only 915 automobiles produced in 1988, which is the largest number of automobiles produced until 2005. The numbers of trucks produced in the next years sharply increase, except the years of production: 2008 and 2009 when their number sharply decreased. Before 2008, an economic boom was observed in the country, therefore, more trucks were registered in these years as well. With the financial crisis starting in 2009, the number of new automobiles significantly decreased. Of the total number of automobiles of this gross weight category that are not older than 1985, 72 % are automobiles produced in 1998 or later.

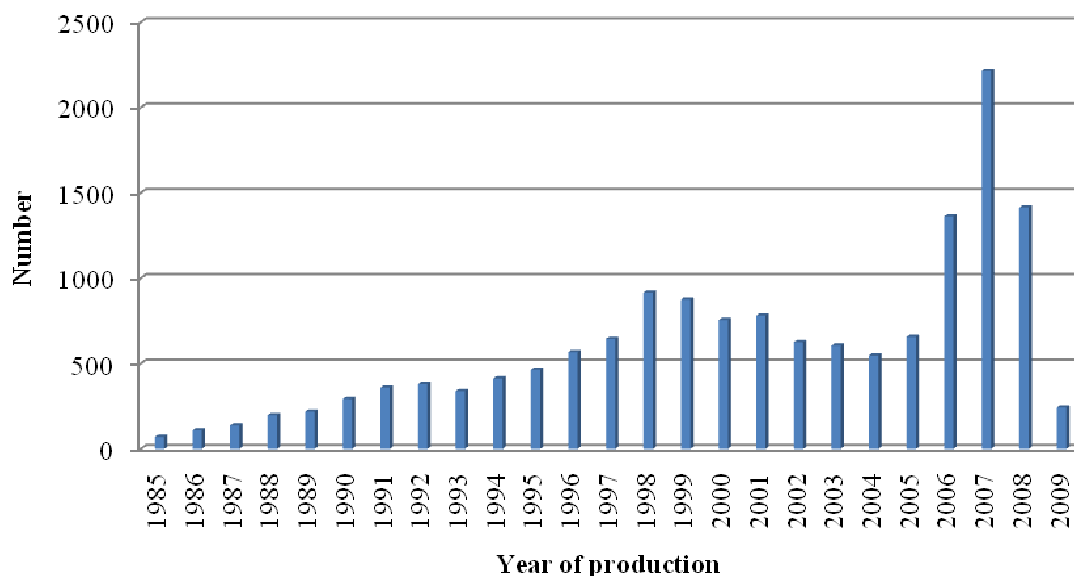


Fig. 3. Distribution of most popular trucks in running order, engine of which uses diesel fuel, with gross weight more than 16000 kg by year of production as of 1 January 2010

The most popular producers of trucks in running order with a gross weight less than 3500 kg and the fuel supply systems used on their engines.

Volkswagen has three most popular models. Caddy accounts for 16 %, Transporter – 51 %, and LT – 27 % of the total number of Volkswagen trucks in the gross weight category of less than 3500 kg. According to the information available in the database, as of 1 January 2010 there were 1654 Volkswagen LT trucks in running order that are not older than 1996. The number of older trucks of

this model is insignificant. Of these automobiles, 150 had an engine capacity of 2799 cm³ and Bosch Common Rail fuel supply systems were installed on them. Bosch single plunger fuel pumps were installed on the rest of the engines. As of 1 January 2010, there were functional 3335 Volkswagen Transporter trucks with a gross weight less than 3500 kg and not older than 1990. The number of older trucks, just like for the LT model, is insignificant. Of them, 173 trucks had an engine capacity of 1896 cm³ and were newer than 2003; 483 trucks had an engine capacity of 2461 cm³ and were newer than 2003. The Bosch Company Unit injector or fuel pump is used in the fuel supply system for the mentioned engines. The Bosch Company single plunger fuel pumps are exploited on all the rest of the engines.

The Mercedes Benz truck model Sprinter accounts for almost 66 % of the total number of Mercedes Benz trucks with a gross weight less than 2500 kg. The Bosch Common Rail fuel supply system is exploited on Mercedes Benz trucks equipped with a CDI diesel engine. As of 1 January 2010, the number of automobiles that were already equipped with this system and were in running order was 1483. 166 automobiles had an engine of a capacity of 2299 cm³, while 369 automobiles had an engine of a capacity of 2874 cm³. The Bosch VE single plunger fuel pump is installed on these two engine models.

Among Ford trucks, only one model is popular – Transit, accounting for 77 % of all Ford trucks with a gross weight of less than 3500 kg. According to the information available in the database, as of 1 January 2010 there were functional 486 trucks of the model Ford Transit with an engine of a capacity of 2496 cm³ that is equipped with a Bosch or Lucas single plunger fuel pump for the fuel supply system. With an engine of a capacity of 2402 cm³, 297 trucks were registered in which Bosch VE single plunger fuel pumps are used, but 178 automobiles with an engine of a capacity of 2198 cm³ had the Bosch Common Rail fuel supply system.

There are two models of Renault trucks that are more popular than others. They are the model Master, accounting for 70 % of the total number of Renault automobiles, and the model Traffic with 19 % of their total number. According to the information available in the database, as of 1 January 2010 the model Master had the following engine capacities: 813 trucks with an engine capacity of 2464 cm³, 728 trucks with 2463 cm³, 116 trucks with 2188 cm³, and 114 trucks with an engine capacity of 2799 cm³. These engines, except the one with an engine capacity of 2799 cm³, are equipped with the Bosch Common Rail fuel supply system. The most popular engine for the model Renault Traffic has an engine capacity of 1870 cm³. As of 1 January 2010, there were 306 such automobiles in working order. The second most popular engine for this model has an engine capacity of 1995 cm³. This engine is also equipped with the Bosch Common Rail fuel supply system.

Almost the entire number of Citroen trucks relates to two models. They are: the model Berlingo and the model Jumper, a little larger in size, which account for 94 % of all Citroen trucks in this gross weight category. According to the information available in the registration database, the most popular is a 1.9D engine for the model Berlingo. As of 1 January 2010, there were 243 functional automobiles with the mentioned engine registered in the database. Of them, 238 automobiles have an engine with a capacity of 1868 cm³. The second most popular is a 1.6D HDI engine with a capacity of 1560 cm³; there were 133 automobiles in working order as of 1 January 2010. Engines with other capacities, used for this model in Latvia, are not popular. The Bosch Common Rail fuel supply system is used for engines with a capacity of 1560 cm³, while Bosch VE, Lucas DPC, and Lucas/Delphi DCN fuel pumps are installed on engines with a capacity of 1868 cm³. The most popular are 2800 cm³ engines in the model Jumper. As of 1 January 2010, 189 such automobiles were registered in the database. The Bosch Common Rail fuel supply system is used for these engines. The second most popular is an engine with a capacity of 2179 cm³. This engine irrespective of the engine code is used for Bosch Common Rail Fuel System.

According to the RTSA database, as of 1 January 2010 there were 25956 functional trucks with a gross weight of less than 3500 kg, starting with the 1985 production year. Five most popular truck brands: Citroen, Mercedes Benz, Ford, Renault, and Volkswagen comprise 19651 trucks. The most popular models of the analysed brands comprise 15627 trucks in total. According to the information obtained from the CSDD database regarding the engine capacities, approximately 6244 trucks use the Common Rail fuel supply system, while 5887 automobiles use the high pressure single plunger fuel pump (see Table 2).

Table 2

Fuel supply systems that use widespread truck producers

Brand	Fuel supply systems				Total
	Common Rail	Unit injectors	Single plunger pumps	Unnamed	
Volkswagen	150	436	4752	-	5338
Mercedes Benz	3041	-	-	-	3041
Ford	128	-	783	1767	2678
Renault	2791	-	114	-	2905
Citroen	133	-	238	1294	1665

The most popular producers of trucks in running order with a gross weight of more than 16000 kg and the fuel supply systems used on their engines

The most popular brand of automobiles in this weight category is Volvo; its two models: FH12 and FH are more popular than others. Actually, this is one and the same model, as FH is the next generation of the model FH12. Irrespective of the production year and engine version, the Unit Injector fuel supply system is used in Volvo FH automobiles. Its producers are Bosch, Delphi, or Lucas. In the period since 1993 when the production of the model FH12 was started, six engine generations were designed: D12A; D12C, D12D, D13A, D13B, and D13C. The figures in these engine codes stand for a rounded engine capacity in litres. The second most popular automobile brand in the weight category of more than 16000 kg is Scania. The most popular models of this producer are 1435 automobiles of the 4-series and 1348 automobiles of the 5-series. Historically, Scania trucks were produced in series. In Latvia, Scania trucks of the 4-series and the 5-series are the most widespread. The designation of its models includes a rounded engine capacity in litres and a serial number to which an automobile belongs. The most popular engine of the 4-series has a capacity of 11.7 litres. A multi-sectional high pressure fuel pump is used for distributing fuel on the engine models with 360 and 400 horsepowers. Engines with 420 horsepowers use the Unit Injector fuel supply system. The second most widespread engine of this series has a capacity of 10.6 litres. A multi-sectional high pressure fuel pump is used on engine models with 320, 340, 360, and 380 horsepowers. Engine models with 330, 340, and 380 horsepowers use the Unit Injector fuel supply system. The third most popular producer is Mercedes Benz that has only one model – Actros – which is more popular than others. The model Actros accounts for more than 60 % of all Mercedes Benz trucks in this gross weight category. A Mercedes Benz Actros engine 501LA is a six cylinder V-shape engine equipped with the Unit Injector fuel supply system. On engines 502LA, which are eight cylinder V-shape engines, the same fuel supply system is installed.

Conclusions

1. The largest part of the trucks in running order consists of trucks with a gross weight of less than 3500 kg and more than 16000 kg.
2. The most popular are trucks, the engine of which consumes diesel fuel. They account for 86 % of all trucks in running order.
3. The most widespread fuel supply systems are the Common Rail systems and Bosch single plunger high pressure fuel pumps among trucks in running order with a gross weight of less than 3500 kg.
4. The Unit Injector fuel supply system is the most popular system among trucks in running order with a gross weight of more than 16000 kg.

References

1. Trucks in running order: 1985-2009 Trucks in running order: 1985-2009 production years. Data of the CSDD publicly unavailable database as of 1 January 2010.
2. Registries trucks: 1985-2009 Trucks in running order: 1985-2009 production years. Data of the CSDD publicly unavailable database as of 1 January 2010.
3. Vehicle e-catalog AUTODATA 2011. – Producer Autodata Limited. [online] [20.03.2011]. Available at: <https://www.autodata-online.net/Online/login/AutodataLogon.aspx>.