LOAD IMPACT MEASUREMENT ON AUTOMOBILE FUEL CONSUMPTION

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Abstract. Fuel is hard to measure and compare in different regimes. It causes ineffective fuel consumption, higher transportation costs and environmental pollution.

In the study are examined factors that affect fuel consumption. There are introduced ways to record fuel consumption of automobiles. As the best is chosen flow method.

In the work is developed methodology for load impact measurement on automobile fuel consumption for constant speed mode and combined cycle, and performed experiments with help of chassis dynamometer and fuel consumption recording device with excellent measurement precision.

Keywords: fuel consumption, chassis dynamometer, flow method, load

Introduction

Automobile fuel consumption economy is an automobile quality that describes rational and efficient fuel consumption [2]. Nowadays when oil resources reduce in the world, but vehicle count grows- this quality gains especial meaning. Automobile owners and transportation companies turn big meaning to expenses that are related to fuel consumption. Ignoring even one factor that affect fuel consumption will cause increase of fuel consumption.

Factors that affect fuel consumption:

- load;
- speed regime;
- automobile and engine construction differences;
- exploitation conditions.

Load is one of the most influential factors that affect fuel consumption, in addition- hard to measure.

Materials and methods

There are three methods how to determine fuel consumption: weight, capacity and flow method. To measure fuel consumption on chassis dynamometer a flow method is used due to fact that flow method is less affected by temperature changes.

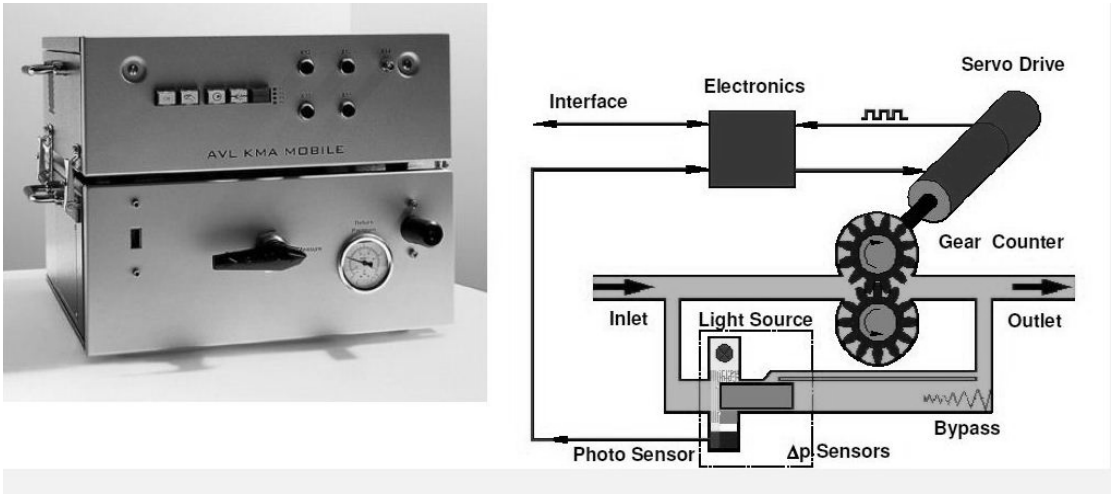
It would be difficult to drive every automobile on the road to measure fuel consumption. It would also be almost impossible to consistently duplicate on-road testing results as there are so

many variables impacting the automobile. Therefore a carefully controlled laboratory (Scientific Laboratory of Bio fuels (Latvia University of Agriculture, Faculty of Engineering)) ensures that all vehicles are tested under identical conditions and that the results are consistent and repeatable.

To provide all necessary measurements with high precision, there can be used equipment offered by the Scientific Laboratory of Bio fuels:

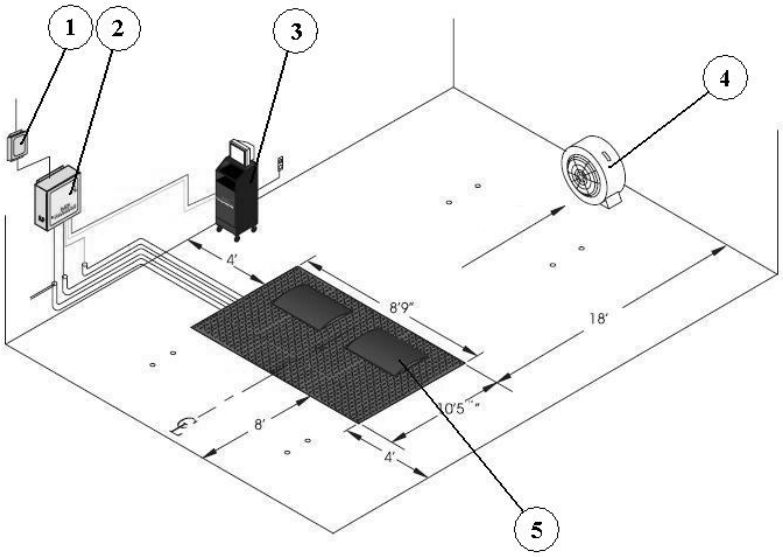
- AVL KMA Mobile fuel consumption meter (Fig. 1);
- Chassis Dynamometer Mustang MD-1750 (Fig. 2).

Fig. 1



AVL KMA Mobile fuel consumption meter and working scheme

Fig. 2



Chassis Dynamometer Mustang MD-1750 components:

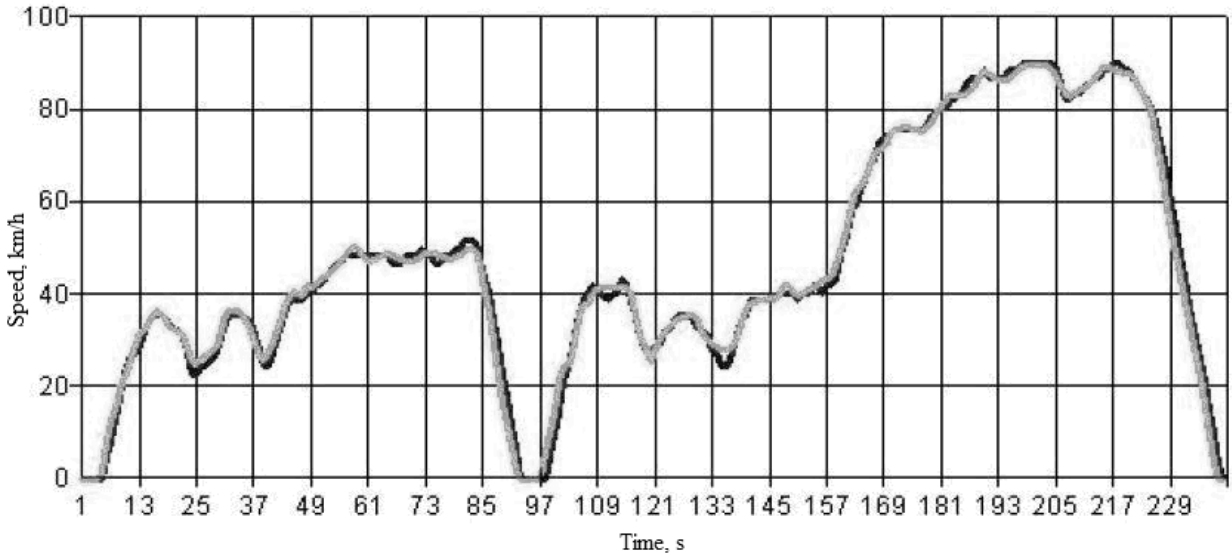
1- fuse box; 2- control platform 3- computer; 4- fan; 5- rolls

A test automobile is mounted on a two-roll laboratory chassis dynamometer that is programmed to take into account the aerodynamic efficiency, rolling resistance and weight of the automobile. Mustang MD-1750 chassis dynamometer can be used only for two wheel drive type automobiles, but four wheel drive is not so popular [4]. AVL KMA Mobile fuel consumption meter substitutes original fuel supply system therefore it needs to be connected and original-disconnected. AVL KMA Mobile can measure all kind of fuels [3].

Measured automobile must be tested for technical condition before measurement, to guarantee safety and data objectivity. Automobile must be at least 6 hours in the laboratory before measurements to achieve laboratory's climatic conditions. Automobile must be secured on chassis dynamometer by straps and keels. Exhaust gas catcher and fan must be adjusted to fit the automobile. Before measurements the automobile engine must be heated up to work temperature.

Automobile must be tested at constant speed mode and combined cycle mode. Each mode should consist of ten measurements at different load. First load should be equipped mass and last- full mass from technical data. Other measurements should be divided in equivalent parts in that range. Constant speed mode need to consist of at least two measurements at different speed (for example at 50 and 90 km/h) for at least 60 seconds. Each measurement should be repeated at least three times. Combined cycle mode IM-240 (Fig. 3) takes 240 seconds and consists of two parts. The first part of the cycle simulates city driving conditions where maximum speed does not exceed 50 km/h, but second part simulates highway conditions. And there is a stop between these parts.

Fig.3



Completed IM 240 driving cycle

Results and discussion

To test developed methodology- practical measurements were done. For test was used passenger car Volkswagen Passat (Fig. 4) made in 1997, front wheel drive, 1.8 liter petrol engine with 125 horsepower, 1200 kg equipped mass and 2000 kg full mass [5].

Fig. 4

Volkswagen Passat completely ready for testing

All collected data (Table 1) was in 0…2% range of variation coefficient, what matches excellent estimation. Data was inserted into a chart (Fig. 5).

Table 1

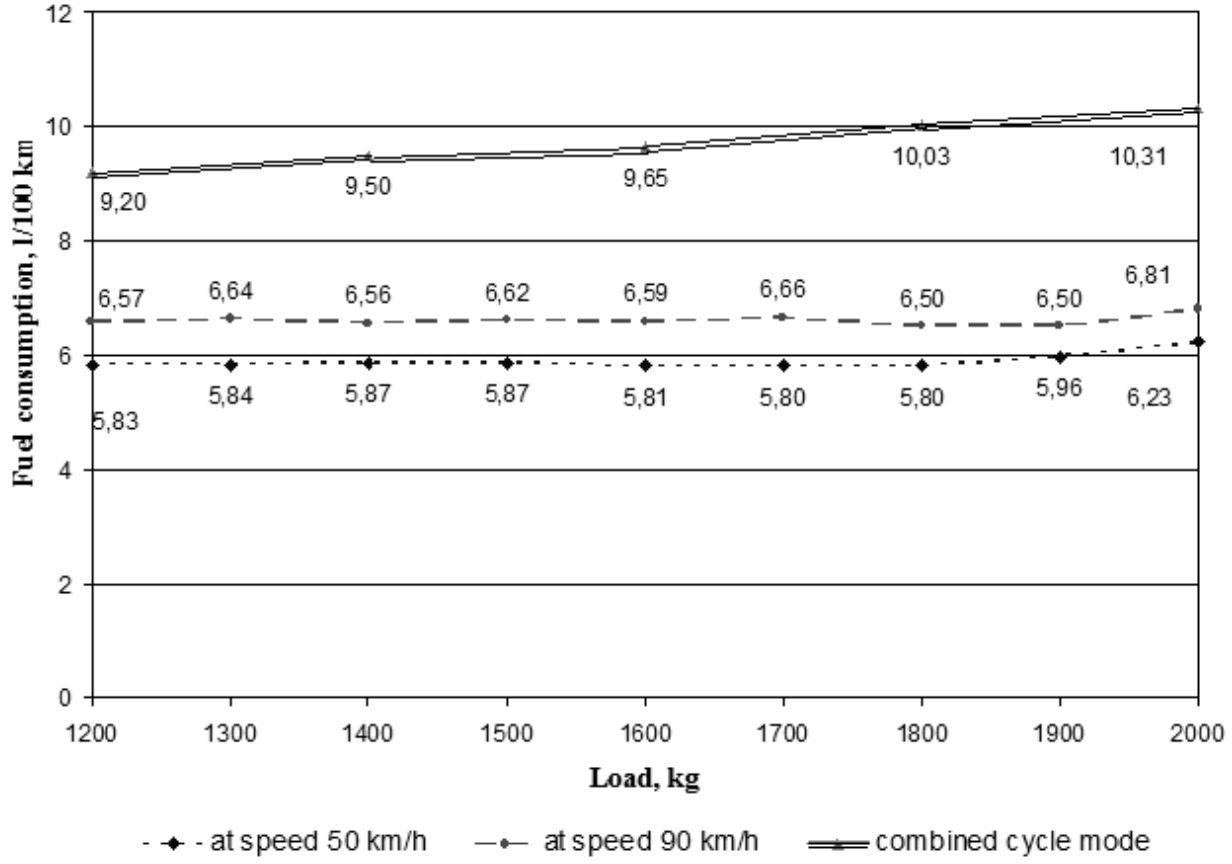
Fuel consumption, l/ 100 km	Load, kg								
	1200	1300	1400	1500	1600	1700	1800	1900	2000
at speed 50 km/h	5,83	5,84	5,87	5,87	5,81	5,80	5,80	5,96	6,23
at speed 90 km/h	6,57	6,64	6,56	6,62	6,59	6,66	6,50	6,50	6,81
in combined cycle mode	9,20	-	9,50	-	9,65	-	10,03	-	10,31

Fuel consumption changes

Automobile fuel consumption changes at constant speed are very little. At 90 km/h fuel consumption increases only at 2000 kg load and reaches 6.81 l/100 km consumption, but at 50 km/h consumption starts to increase from 1900 kg load and reaches its maximum value 6.23 l/100km at 2000 kg load. It's according to fact that fuel consumption increases near engine full duty [1].

Automobile fuel consumption change in combined cycle mode is almost linear increase. Difference between 1200 and 2000 kg load is 1.11 l/ 100 km with maximum value of 10.3 l/100 km fuel consumption. Unlike constant speed mode, combined cycle mode consists from constant braking and acceleration stages. To overcome this inertia fuel consumption increases 40% from constant speed mode.

Fig. 5



Fuel consumption changes as an effect of the load

Conclusions

1. Flow method is used to measure fuel consumption on chassis dynamometer and it gives excellent measurement precision.

2. Automobile fuel consumption change as an effect of the load increasing load at constant speed is a very little increase, but in combined cycle mode is almost linear 1.6 % increase for every 100 kg.

3. Fuel consumption is almost two times bigger in combined cycle with average speed 47.3 km/h than at constant 90 km/h speed.

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