EFFECT OF EMISSION MEASUREMENT OF TOXIC EXHAUST COMPONENTS OF AUTOMOTIVE VEHICLES EQUIPPED WITH SPARK-IGNITION ENGINES ON THE ENVIRONMENT DURING MANDATORY CHECK TESTS AT VEHICLE INSPECTION STATIONS

The article describes aspects related to the impact of toxic components of exhaust gases from motor vehicles, which are equipped with spark-ignition engines for environmental pollution and a negative impact on human health. The paper presents aspects related to the structure of passenger cars in Poland and the European Union, which are in operation and subject to mandatory control tests. The methodology of performing mandatory periodic check-ups in diagnostic stations and on the basis of the developed research results also includes a group of vehicles that does not meet the legal requirements for the measurement of exhaust emissions. The results of passenger car tests in selected European Union countries have been presented.

The danger to people is the emission of solid particles, which is a barrier to the development of modern combustion engines. The effect of particulate matter on climate change is a complex problem, in the global view the particles in the atmosphere exert an influence on the slowing down of atmospheric warming. Estimation of the global impact of PM particles on global climate and local meteorology and subsequent health and environmental effects due to specific changes in particulate emissions at local level are uncertain.

In Poland, preliminary air quality assessment results indicate that particulate matter emissions for years, systematically decreasing is still a very important component of air quality [3]. Communication pollution in large urban agglomerations accounts for 75-80% of total contamination. Unfavorable phenomena, especially in the urban environment, are exacerbated by the reduction of the role of public transport with a constant increase in the number of used cars [4].

2. STRUCTURE OF TRANSPORT

In Poland, in the period since 1990, with the economic growth, there has been a continuous increase in the number of motor vehicles in continuous use. In December 2016. All vehicles, trucks, buses, motorcycles and other vehicles listed in Table 1 were registered. The largest group is 21675388 passenger vehicles, which accounts for 75.6% of the overall condition of vehicles in Poland. There is a problem of ensuring proper technical condition of vehicles that are in service for many years. The average age of passenger cars in service in December 2016 in Poland it was 15.5 years. Over the last period, a significant increase in the number of vehicles registered per 1000 inhabitants has been observed in Poland [5].

| Year       | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2016 |
|------------|------|------|------|------|------|------|------|
| Personal Car | 5261000 | 7517000 | 9991000 | 12339000 | 172398 | 20003863 | 21675388 |
| Truck Car   | 128700 | 187900 | 23037149 | 26472274 | 28601037 | 30955000 | 32167900 |
| Motorcycles | 1351000 | 1351000 | 1337923 | 1705675 | 1832211 | 2277230 | 23037149 |
| Motorcycles | 1301000 | 1351000 | 1337923 | 1705675 | 1832211 | 2277230 | 23037149 |
| Total       | 9041000 | 11186000 | 14106000 | 16815923 | 23037149 | 26472274 | 28601037 |

Tab. 1. Structure of vehicles[4]
and consist of verifying that the vehicle meets the technical specifications set forth in the legislation. Control is mandatory and is performed for new passenger vehicles after three years of operation followed by two and subsequent tests taking place after another year of operation in accordance with the legislative regulations of the legislator. Exhaust gas emission measurement was performed when the engine was heated above 70 °C for engine oil and above 80 °C for coolant. The exhaust gas analyzer was introduced into the engine exhaust system immediately before the measurement at a depth of at least 30 cm. The engine's crankshaft rotational speed was maintained for more than 15 seconds and then lowered to idle speed [6].

**3. FINDINGS**

The study was conducted under real conditions at the Diagnostic Vehicle Station (DVS) during mandatory screening tests. The study involved a group of 400 spark-ignited cars with a 3.5 DMC rating that measured engine exhaust emissions, carbon monoxide (CO), hydrocarbons (HC), and lambda excess (λ). Table 4 presents vehicle test results [6].

**4. Conclusions**

Fig. 5 presents the results of a study of 60 vehicle groups produced before 1995 that did not meet the 8-volume emission requirements (CO), after the 1995 production year, participated in 209 (negative) and 52 (negative) tests. Which were produced in the
years 1995-2004, did not meet the 118 lambda (λ) emissions requirements. The 209 and 192 groups were involved in the HC (HC) study. The negative result for the 79 increased and idling 100 Pcs. After the year of manufacture 2004 participated in the study of coefficient (λ) 138 pcs negative result 26 pcs.[8]. Fig. 6 shows the results showing that vehicles manufactured before 1995 did not meet the emission requirements (CO) in 13.3%, after the 1995 production year at 24.88% and 47.84% respectively. 33.06%. Cars that were produced between 1995 and 2004 do not meet the emission requirements for lambda (λ) at 56.46%, produced after 2004 do not meet the requirements at 18.84%.

Fig. 6. Study results [8]

Fig. 7. Study results [8]

The conducted research in selected countries in the European Union presented in Table 5 was carried out on a group of passenger cars with spark ignition in the number of 1374. From the tested group, it did not meet the requirements regarding the permissible emission values of toxic components of the exhaust gas of 113 vehicles, which accounted for 8.22% of the group of passenger cars tested.

Tab.5. Study results [9]

The presented results on the graph (Fig. 8) show selected countries in which the tests of admissible values of toxic components of exhaust gases and the number of passenger cars that took part in research in selected countries in the European Union were carried out.

Fig. 8. Study results in EU. [9]

SUMMARY

The article describes problems related to the impact of environmental pollution on car transport. For the reasons for atmospheric pollution, one of the main sources is the technical state of the fuel supply systems, flue gas exhaust gas purification equipment, which directly affects the reduction of toxic emissions of CO, HC and particulate matter from cars in service. Essential sources of environmental pollution are consumables, gasoline and diesel oils, and lubricants that contain many toxic compounds, sulfur and particu-
lates. Analysis of the transport structure in Poland shows that from 1990 to 2016, there was an increase in the number of all cars in operation by 19560037 units and passenger cars by 16414388 units. The European Union is experiencing a dynamic growth in the number of passenger cars in operation in the analyzed area until 2030, the number of cars will increase by about 50 million pieces. The increase of such a large number of motor vehicles will have an impact on the increase of environmental pollution and increase in population incidence. The results show that vehicles manufactured before 1995 did not meet the emission requirements (CO) in 13.3%, after the 1995 production year at 24.88% and respectively, 33.06%. Cars that were produced between 1995 and 2004 do not meet the emission requirements for lambda (λ) at 56.46%, produced after 2004 do not meet the requirements at 18.84%. The European Union is experiencing a dynamic growth in the number of passenger cars in operation in the analyzed area until 2030, the number of cars will increase by about 50 million pieces. The increase of such a large number of motor vehicles will have an impact on the increase of environmental pollution and human health.

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Authors:
Prof. dr hab. inż. Marek Idzior - Politechnika Poznańska, Instytut Silników Spalinowych i Transportu, ul. Piotrowo 3, Poznań 60-965 Tel:+ 48 61 665 20 22, Fax:+ 48 61 665 21 19, marek.idzior@put.poznan.pl
Mgr. inż. Edward Czapliński - Politechnika Poznańska, Instytut Silników Spalinowych i Transportu, ul. Piotrowo 3, Poznań 60-965 Tel:+ 48 61 665 20 22, Fax:+ 48 61 665 22 04, edward.czapinski@doctorate.put.poznan.pl
Mgr. inż. Marzena Korzik - Politechnika Poznańska, Instytut Silników Spalinowych i Transportu, ul. Piotrowo 3, Poznań 60-965 Tel:+ 48 61 665 20 22, Fax:+ 48 61 665 22 04, marzena.korzik@doctorate.put.poznan.pl

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