Content

List of performers

Position	Full name	Signature
Deputy Director of the Institute, c.t.s.	O. I. Teslenko	
Director of the Department of Energy Saving, Master of power Engineering	O. P. Samchenko	
Specialist in ecology, Master of Environmental science and protection	N. P. Mylko	

List of abbreviations and symbols

GS – gas station;

ICE – internal combustion engine;

DF – diesel fuel;

SSU – the state standard of Ukraine;

HPFP – high pressure fuel pump;

FW – FuelWell (device, which decrease fuel consumption and toxic exhaust gases).

Introduction

Motor transport is the most important source of environmental pollution. The greatest pollution of atmospheric air comes from power plants, working on carbohydrate fuel (gasoline, diesel, fuel oil, coal natural gas, etc.). The amount of pollution is determined by the amount of combustible fuel and the organization of the combustion process. The main sources of atmospheric pollution are vehicles with internal combustion engines (ICEs).

The main components which are emitted into the atmosphere during on burning different types of fuel in all types of engines are non-toxic carbon dioxide (CO_2) and water vapor (H_2O). However, harmful substances such as carbon monoxide, sulfur oxides, nitrogen, lead compounds, soot, hydrocarbons, including carcinogenic benzopyrene (C_2OH_{12}), unburned particles of fuel and many others are emitted into the atmosphere too.

The amount of harmful substances entering the atmosphere in the composition of the exhaust gases, depends on the general technical condition of cars and especially from the engine, the source of the greatest pollution. In case of violation of the regulation of the carburetor CO emissions increase in 4 - 5 times.

In the exhaust gases of cars engines contains more than 200 toxic chemical compounds, the overwhelming part of which are various hydrocarbons.

In view of this, in recent years the issue of equipped vehicles with engines and fuel systems that have a minimal impact on the environmental becomes relevant.

One such means of reducing the negative environmental impact of internal combustion engines is the use of special devices, which decrease harmful emissions into the atmosphere and fuel economy, in particular FuelWell. Such devices are used in the fuel system of vehicle and for pre-treatment of fuel supplies to the engine.

Apart from the environmental impact, FuelWell also has a fuel economy effect, which can range from 5 to 30 %[1] of traditional combustion.

In this works the results of measurements of the exhaust gas composition of the gasoline engine of internal combustion of vehicle equipped with the FuelWell device are given.

[1] According to producers

1 Normative base

During performing the work the following normative documents were used:

- SSU 4276:2004 «Standard's system in the field of environmental protection and rational use of resources. Atmosphere. Standards and methods for measuring the smoke of exhaust gases of cars with diesel engines and gas dischargers».
- SSU 4277:2004 «Standard's system in the field of environmental protection and rational use of resources. Atmosphere. Standards and methods for measuring the content of carbon monoxide and hydrocarbons in the exhaust gases of cars with engines operating on gasoline or gas fuels».
- SS 17.2.1.02-76 «Protection of Nature. Atmosphere. Terms and definitions engine's emissions, cars, tractors, self-propelled agricultural and road construction machinery».
- SS 17.2.2.01-84 «Protection of Nature. Atmosphere. Diesel engines for automobiles. Smoke of exhaust gases. Standards and methods of measurements».
- SS 17.2.2.02-98 «Protection of Nature. Atmosphere. Norms and methods for determining the smokiness of exhaust gases of diesel engines, tractors and self-propelled agricultural machinery».
- SS 24585-81 «Locomotive's diesels, ship's diesel and industrial engines. Emissions of harmful substances with exhaust gases. Norms and methods of measurements».
- SSU 2501-94 «Gas analyzers for vehicle emissions monitoring. General technical requirements and tests methods».
- SSU 7687:2015 «EURO gasoline fuel. Specifications».
- SSU 7688:2015 «EURO diesel fuel. Specifications».

2 Terms

2.1 Characteristics of the vehicle and the internal combustion engine

The exhaust gas measurement was carried out on the vehicle Hyundai Elantra 1.6 (HD) (Fig. 2.1). The main technical characteristics of the vehicle are given in the table 2.1.

Fig. 2.1 – The look of the vehicle (Hyundai Elantra 1.6 (HD)

The table 2.1 – The main technical characteristics of the vehicle (Hyundai Elantra 1.6 (HD)

№	Denomination	Meaning
	General information	
1	Type of bodywork	Sedan
2	Numbers of seats	5
3	Numbers of doors	4
3	Car class	C
5	Start of production	2006 – 2010 years
	Internal combustion engine	
6	Engine's type	G4FC
7	Engine's capacity	1591 sm^3
8	Power	128 h.p. 89,7 kW 6300 r./min.
9	Torque	153 Нм 4200 r./min.
10	Fuel supply system	Injector with distributed sprayer
11	Fuel's type	Gasoline
	Transmissions	
12	Gearbox type	Front
13	Type of drive	4-auto HiVec H-matic

	Performance characteristics	
14	Dispersal to 100 km/h.	10 s
15	Maximum speed	183 km/h.
16	Fuel consumption on 100 km (robot) In the city Out of the city Mixed cycle	 8,9 liters 5,2 liters 6,6 liters
17	Norm of toxicity	EURO IV
	Dimensions	
18	Length	4505 mm
19	Width	1775 mm
20	Height	1490 mm
21	Wheelbase	2650 mm
22	Total weight	1680 kg
23	Fitted mass	1250 kg

Beijing Hyundai Motor Co. company G4FC's engine type is installed.

The G4FC engine, part of the GAMMA series of Hyundai, has begun to be serially installed on a Hyundai/Kia car since 2007. This multiple gasoline four with a top distribution is made according to the classic scheme DOHC. Located in the cylinder head they control the operation of 16 values.

This is the smallest Hyundai engine that uses Derict Fuel Injection (DFI). The applied design of the provision of injection provides a calculated fuel economy of up to 5,8 l/100 km, emission reduction and high reliability.

Hyundai G4FC 1.6 engine is used for installing on the such vehicles as Hyundai Solaris, Hyundai Elantra, Kia Rio, Kia Ceed, Kia Cerato, Hyundai i20 and Hyundai i30.

The engine has a closed-circuit liquid cooling system with forced circulation. Combined lubrication system: under pressure and spray.

The main technical characteristics of the vehicle are listed on the table 2.2.

The table 2.2 – The main technical characteristics of the vehicle (G4FC)

№	Denomination	Meaning
1	Factory marcing	G4FC
2	Engine capacity	89,7 kW /128 h.p.
3	Engine volume	1591 cube sm.
4	Number of cylinders	4 pieces
5	Number of valves	16 pieces
6	Engine manufacturer	Hyundai
7	Cylinder diameter	77 mm

8	Piston stroke	85,4 mm
9	Indigenous supports	5 pieces
10	Capacity index	72 h.p. on 1 liter (1000 sm^3) volume

During the measurements of the exhaust gas composition of this engine, the vehicle and ICE were in normal operation without technological deviations. The management of the vehicle was carried out on a professional level without the use of «aggressive» control. Thus, neither the state of the vehicle nor the style of management had a significant impact on the course of measurements and on the results obtained.

2.2 Methodolody and tools of instumental measurements

During the measurement work, measurements were made in two main directions:

- measurement of the exhaust ducts of the ICE;
- measurement of specific fuel consumption.

Measurement of the exhaust gas composition of the gasoline's internal combustion engine (SSU 4276:2004, SSU 4277:2004 and others.).

These documents contain requirements for measuring instruments used for measuring the content of carbon monoxide, hydrocarbons, and the smoke of exhaust gases of cars.

The measurement of the composition of harmful substances in the exhaust gases of the ICE was carried out on a special dynamometer stand, which is used to simulate the movement of the car along the road and adjust characteristics of the engine under load.

Measurements were made due to using the European methodology NEDC (New European Driving Cycle), which involves simulating the movement of the car on a dynamometer. The duration of the test cycle is 1220 seconds (4 tests for 195 seconds + 1 test 400 seconds). The cycle length is 11007 meters. An average speed is 33,6 km/h. Maximum speed is 120 km/h.

The picture 2.2 shows NEDC driving cycle for typical tests of cars.

NEDC testing is divided into two parts. The first – involves the movement of the car through the virtual «city» (UDC — Urban Driving Cycle). Car is sent on the trip after precipitate at room temperature 20-30°C.

Calculation of fuel consumption and harmful emissions begins immediately after the engine starts, but the first 11 seconds vehicle do not move from the place. Them the explored model moves on typical Europeans streets. Such conditions are simulated by cyclic overclocking and braking with short stops and segments of motion at constant speed.

The speed changes from 20 km/h to 50 km/h. The test takes 780 s, during this time, the car will overcome the «city» four times, having traveled a little over four kilometers at an average speed of 18,7 km/h.

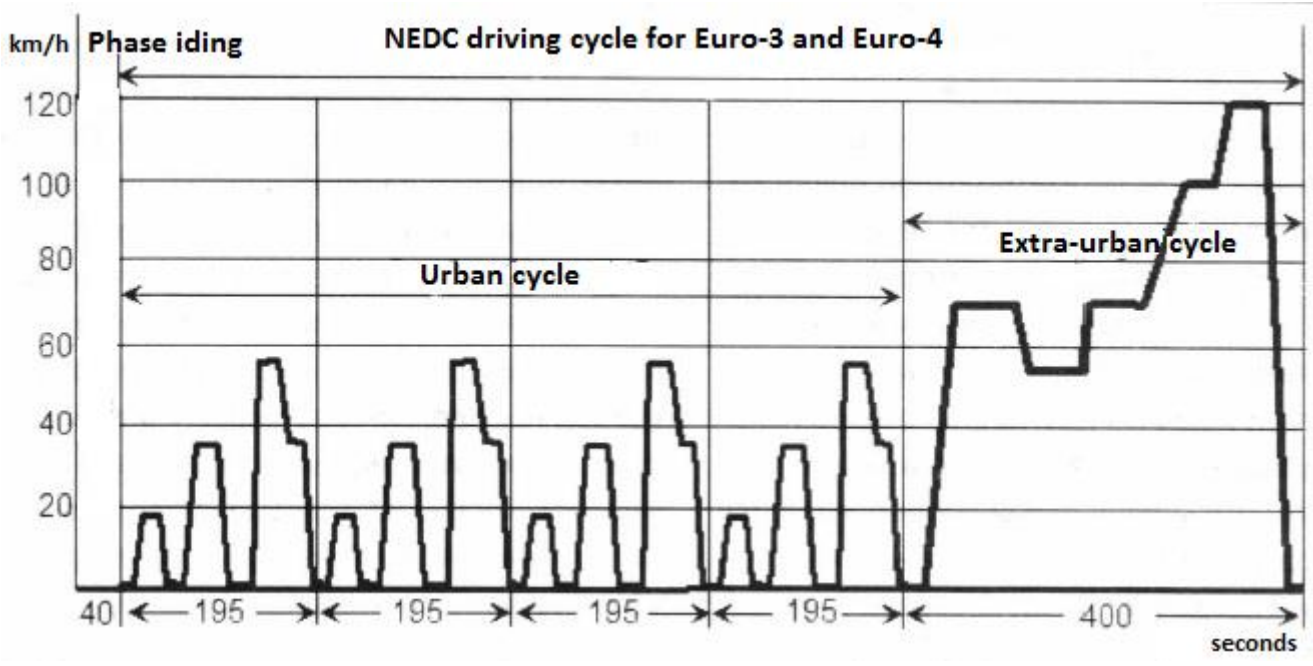

Fig. 2.2 –NEDC driving cycle for typical tests of cars

The second stage of NEDC - «suburb» (EUDC, Extra-Urban Driving Cycle). It is not so long, only 400 s, but the final mileage goes out more -–almost seven kilometers. That is why, because an average speed is more than 62,6 km/h. In this case, vehicle is gradually gaining speed to 120 km/h. But only once, as can be seen in the graph, after this vehicle is braked to a complete stop (Fig. 2.2).

2.3 Measurement conditions

The main parameters and conditions for measuring work are given on the table 2.3.

The table 2.3 – The main parameters and conditions for measuring work

№	Denomination	Meaning	Note
1	Date of measurement	15.08.2017 p.	
2	Time of measurement	from 11:00 to 18:00	
3	Environmental temperature	+25…+28^{0}C	
4	The temperature inside the vehicle	+19,5^{0}C	
5	Type of dynamometer stand	DynoProject	

		model DP4L-Shnchro	
6	Vehicle type	Hyundai Elantra 1.6 (HD)	
7	Fuel type	Gasoline 100 MUSTANG	
8	Speed	from 20 to 120 km/h	
9	Measurement methodology	NEDC	

3 Results of measurements

The results of the measurements determined the composition of the exhaust gases of the ICE and the specific fuel consumption.

3.1 The results of the measurements of the exhaust gas content of the internal combustion engine

During the measurement of the composition of the exhaust gas of the gasoline ICE, a number of indicators were obtained, the values of which were averaged. All received results were systematized depending on the cycle of vehicle's movement and speed, as well as operating conditions of the vehicle (without and with the FuelWell).

In addition to the exhaust gas of the ICE also recorded their temperature, which on average was 80…300 ^{0}C (depending on the speed of the vehicle, that mode of operation of ICE).

Measurement of all components of exhaust gases (except O_2 and CO_2) was carried out in mg/m^3 of exhaust gases.

After receiving measurement's results, their recalculation and the obtained results in g/km, which correspond to the European normative documents were performed.

The measurement results and calculation of the composition of the exhaust gases of the internal combustion engine are given on the tables 3.1 and 32 (mg/m^3) and on the tables 3.3 and 3.4 (g/km).

Comparison of the exhaust gas composition without and with the FuelWell is shown on Figures 3.1 – 3.6.

The table 3.1 – Results of the measurement of the exhaust gas content of the ICE without the FuelWell (mg/m^3)

№	Speed of vehicle, km/h.	An average composition of the exhaust gases of ICE							Temperature of exhaust gases, ^{0}C	Note
		O_2, %	CO, mg/m^3	NOx, mg/m^3	NO, mg/m^3	NO_2, mg/m^3	SO_2, mg/m^3	CO_2, %		
Urban driving cycle										
1	20	0,79	4586	1574	1319	15	0,0	16,24	82,7	UDC 1
2	40	0,45	4571	1965	1277	11	0,0	15,95	88,0	
3	60	0,15	4381	2643	1724	6	0,0	15,46	108,2	
4	40	0,08	5486	2104	1369	9	0,0	16,78	121,8	
5	20	0,07	4865	1382	901	4	0,0	16,61	115,8	UDC 2
6	40	0,10	4075	2380	1554	3	0,0	15,32	136,4	
7	60	0,11	5003	3575	2329	12	0,0	16,46	148,6	
8	40	0,06	5527	2594	1737	6	0,0	16,65	149,3	
9	20	0,05	5364	2710	1658	3	0,0	17,31	140,6	UDC 3
10	40	0,09	4732	3371	2201	4	0,0	16,14	165,5	
11	60	0,12	6194	4115	2745	16	0,0	17,76	173,6	
12	40	0,09	5832	3671	2393	10	0,0	17,25	178,7	
13	20	0,07	4960	2314	1506	10	0,0	16,72	150,0	UDC 4
14	40	0,07	4384	1931	1260	4	0,0	15,72	159,2	
15	60	0,06	4164	2554	1665	6	0,0	15,21	160,8	
16	40	0,06	4474	2423	1581	5	0,0	15,41	160,1	
Extra-urban driving cycle										
17	70	0,04	4304	2591	1839	1	0,0	15,39	155,6	EUDC
18	50	0,07	5037	3468	2264	3	0,0	16,44	165,3	
19	70	0,10	6244	4867	3176	9	0,0	18,04	190,9	
20	100	0,13	6539	5377	3507	12	0,0	18,49	240,1	
21	120	0,13	6539	5418	3532	15	0,0	18,55	299,8	

The table 3.2 – Results of the measurement of the exhaust gas content of the ICE without the FuelWell (g/km)

№	Speed of vehicle, km/h.	An average composition of the exhaust gases of ICE							Temperature of exhaust gases, ^{0}C	Note
		O_2, %	CO, g/km	NOx, g/km	NO, g/km	NO_2, g/km	SO_2, %	CO_2, %		
Urban driving cycle										
1	20	0,79	6,24	2,14	1,79	0,020	0,0	16,24	82,7	UDC 1
2	40	0,45	5,95	2,56	1,66	0,014	0,0	15,95	88,0	
3	60	0,15	5,46	3,30	2,15	0,007	0,0	15,46	108,2	
4	40	0,08	6,78	2,60	1,69	0,011	0,0	16,78	121,8	
5	20	0,07	6,61	1,88	1,22	0,005	0,0	16,61	115,8	UDC 2
6	40	0,10	5,32	3,10	2,03	0,004	0,0	15,32	136,4	
7	60	0,11	6,46	4,61	3,01	0,015	0,0	16,46	148,6	
8	40	0,06	6,65	3,12	2,09	0,007	0,0	16,65	149,3	
9	20	0,05	7,31	3,69	2,26	0,004	0,0	17,31	140,6	UDC 3
10	40	0,09	6,14	4,38	2,86	0,005	0,0	16,14	165,5	
11	60	0,12	7,76	5,16	3,44	0,020	0,0	17,76	173,6	
12	40	0,09	7,25	4,56	2,98	0,012	0,0	17,25	178,7	
13	20	0,07	6,72	3,14	2,04	0,014	0,0	16,72	150,0	UDC 4
14	40	0,07	5,72	2,52	1,64	0,005	0,0	15,72	159,2	
15	60	0,06	5,21	3,20	2,08	0,008	0,0	15,21	160,8	
16	40	0,06	5,41	2,93	1,91	0,006	0,0	15,41	160,1	
Extra-urban driving cycle										
17	70	0,04	5,39	3,25	2,30	0,001	0,0	15,39	155,6	EUDC
18	50	0,07	6,44	4,43	2,89	0,004	0,0	16,44	165,3	
19	70	0,10	8,04	6,27	4,09	0,012	0,0	18,04	190,9	
20	100	0,13	8,49	6,98	4,55	0,016	0,0	18,49	240,1	
21	120	0,13	8,55	7,09	4,62	0,020	0,0	18,55	299,8	

The table 3.3 – Results of the measurement of the exhaust gas content of the ICE with the FuelWell (mg/m^3)

№	Speed of vehicle, km/h.	An average composition of the exhaust gases of ICE							Temperature of exhaust gases, ^0C	Note
		O_2, %	CO, mg/m^3	NOx, mg/m^3	NO, mg/m^3	NO_2, mg/m^3	SO_2, mg/m^3	CO_2, %		
Urban driving cycle										
1	20	0,49	2191	1838	1341	8,0	41	12,20	178,4	UDC 1
2	40	0,14	3376	1699	1106	7,0	89	13,26	188,7	
3	60	0,08	3267	2379	1551	7,0	69	13,13	179,9	
4	40	0,07	3148	1513	986	5,0	19	13,08	170,6	
5	20	0,08	2281	1218	793	4,0	17	12,29	157,0	UDC 2
6	40	0,04	3902	1627	1062	2,0	52	13,77	152,2	
7	60	0,05	2718	2977	1344	3,0	16	12,69	151,8	
8	40	0,06	3703	2166	1411	7,0	33	13,53	151,3	
9	20	0,04	3193	1298	847	2,0	65	13,20	142,1	UDC 3
10	40	0,04	2932	2107	1376	1,0	63	12,84	141,2	
11	60	0,05	2913	2036	1330	2,0	57	12,79	138,2	
12	40	0,03	3053	1692	1106	1,0	34	13,01	138,0	
13	20	0,02	3475	1139	1745	6,0	34	13,49	130,2	UDC 4
14	40	0,03	2578	1577	1031	3,0	37	12,49	130,9	
15	60	0,04	2999	2706	1168	1,0	80	12,87	133,4	
16	40	0,04	2996	1997	1304	2,0	17	12,88	133,0	
Extra-urban driving cycle										
17	70	0,05	2404	2762	1805	4,0	57	12,46	143,1	EUDC
18	50	0,07	2631	2224	1525	3,0	75	12,59	153,8	
19	70	0,07	2410	2463	1869	4,0	59	12,35	155,0	
20	100	0,09	2949	2804	2875	6,0	52	12,73	169,7	
21	120	0,09	2735	2867	2755	9,0	62	12,64	200,0	

The table 3.4 – Results of the measurement of the exhaust gas content of the ICE with the FuelWell (g/km)

№	Speed of vehicle, km/h.	An average composition of the exhaust gases of ICE							Temperature of exhaust gases, ^{0}C	Note
		O_2, %	CO, g/km	NOx, g/km	NO, g/km	NO_2, g/km	SO_2, %	CO_2, %		
Urban driving cycle										
1	20	0,49	2,20	1,84	1,35	0,008	0,0015	12,20	178,4	UDC 1
2	40	0,14	3,26	1,64	1,07	0,007	0,0033	13,26	188,7	
3	60	0,08	3,13	2,28	1,49	0,007	0,0026	13,13	179,9	
4	40	0,07	3,08	1,48	0,97	0,005	0,0007	13,08	170,6	
5	20	0,08	2,29	1,22	0,80	0,004	0,0006	12,29	157,0	UDC 2
6	40	0,04	3,77	1,57	1,03	0,002	0,0020	13,77	152,2	
7	60	0,05	2,69	2,94	1,33	0,003	0,0006	12,69	151,8	
8	40	0,06	3,53	2,07	1,35	0,007	0,0012	13,53	151,3	
9	20	0,04	3,20	1,30	0,85	0,002	0,0024	13,20	142,1	UDC 3
10	40	0,04	2,84	2,04	1,33	0,001	0,0024	12,84	141,2	
11	60	0,05	2,79	1,95	1,27	0,002	0,0021	12,79	138,2	
12	40	0,03	3,01	1,67	1,09	0,001	0,0013	13,01	138,0	
13	20	0,02	3,49	1,14	1,75	0,006	0,0013	13,49	130,2	UDC 4
14	40	0,03	2,49	1,53	1,00	0,003	0,0014	12,49	130,9	
15	60	0,04	2,87	2,59	1,12	0,001	0,0030	12,87	133,4	
16	40	0,04	2,88	1,92	1,25	0,002	0,0006	12,88	133,0	
Extra-urban driving cycle										
17	70	0,05	2,46	2,82	1,85	0,004	0,0021	12,46	143,1	EUDC
18	50	0,07	2,59	2,19	1,50	0,003	0,0028	12,59	153,8	
19	70	0,07	2,35	2,40	1,82	0,004	0,0022	12,35	155,0	
20	100	0,09	2,73	2,60	2,66	0,006	0,0020	12,73	169,7	
21	120	0,09	2,64	2,77	2,66	0,009	0,0023	12,64	200,0	

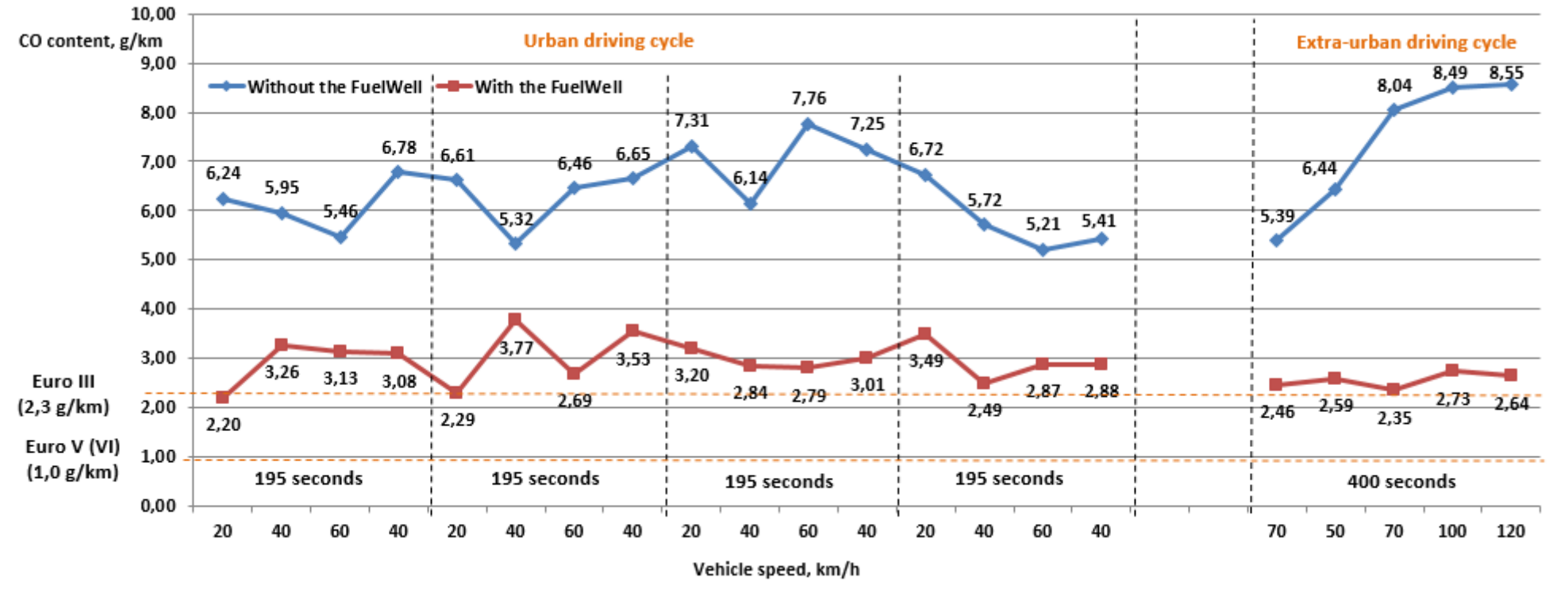

Fig. 3.1 – The content of carbon monoxide (CO) of the exhaust gases of the ICE

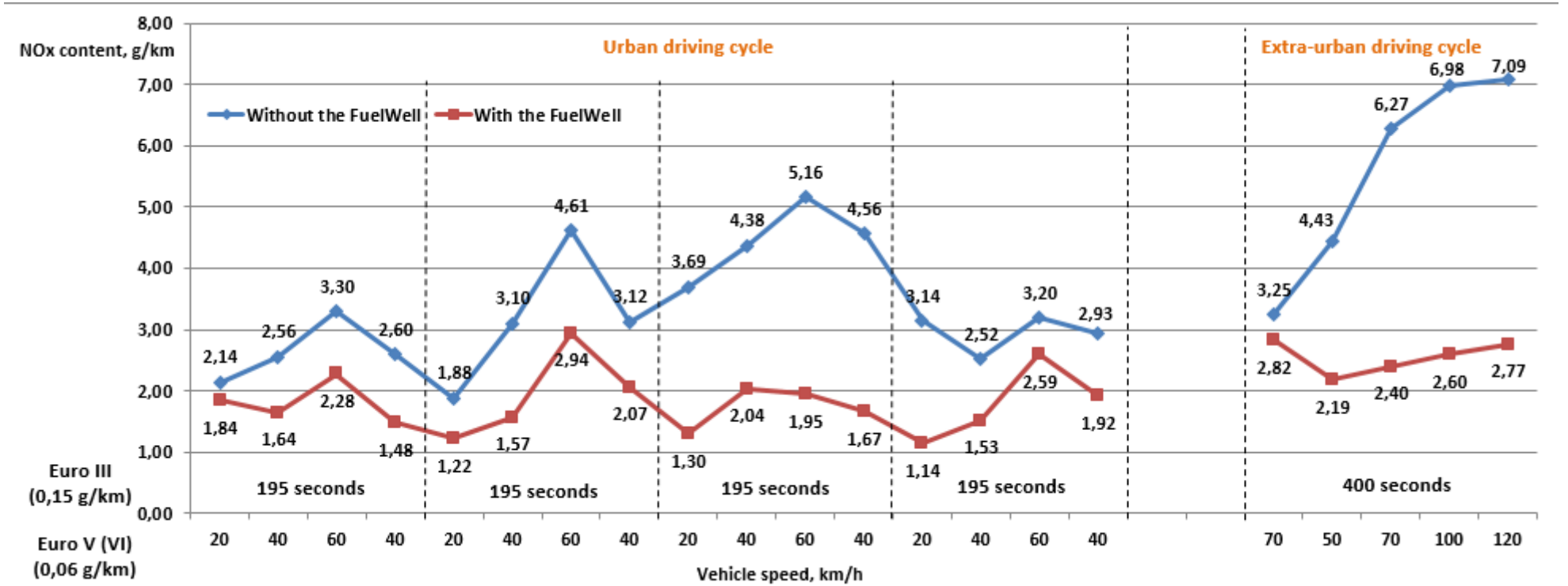

Fig. 3.2 – The content of nitrogen oxides (NOx) of the exhaust gases of the ICE

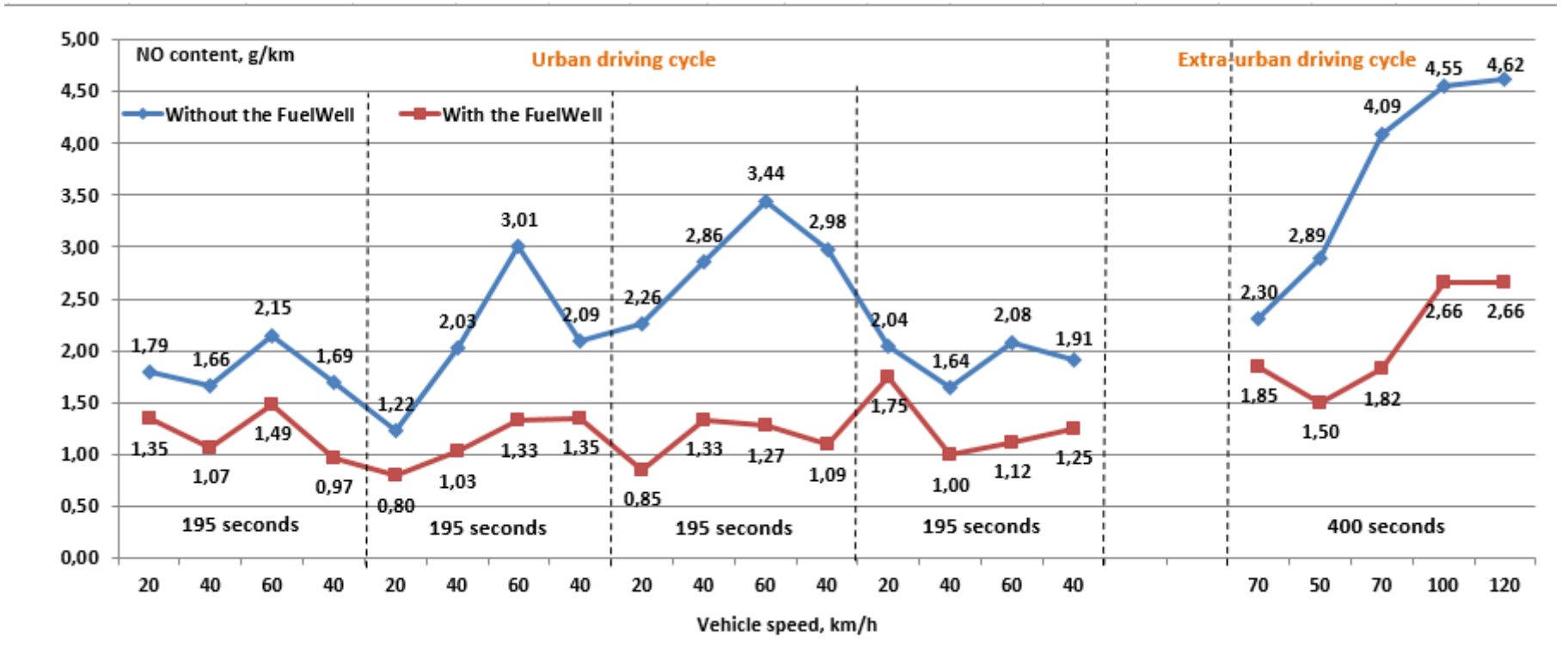

Fig. 3.3 – The content of nitric oxide (NO) of the exhaust gases of the ICE

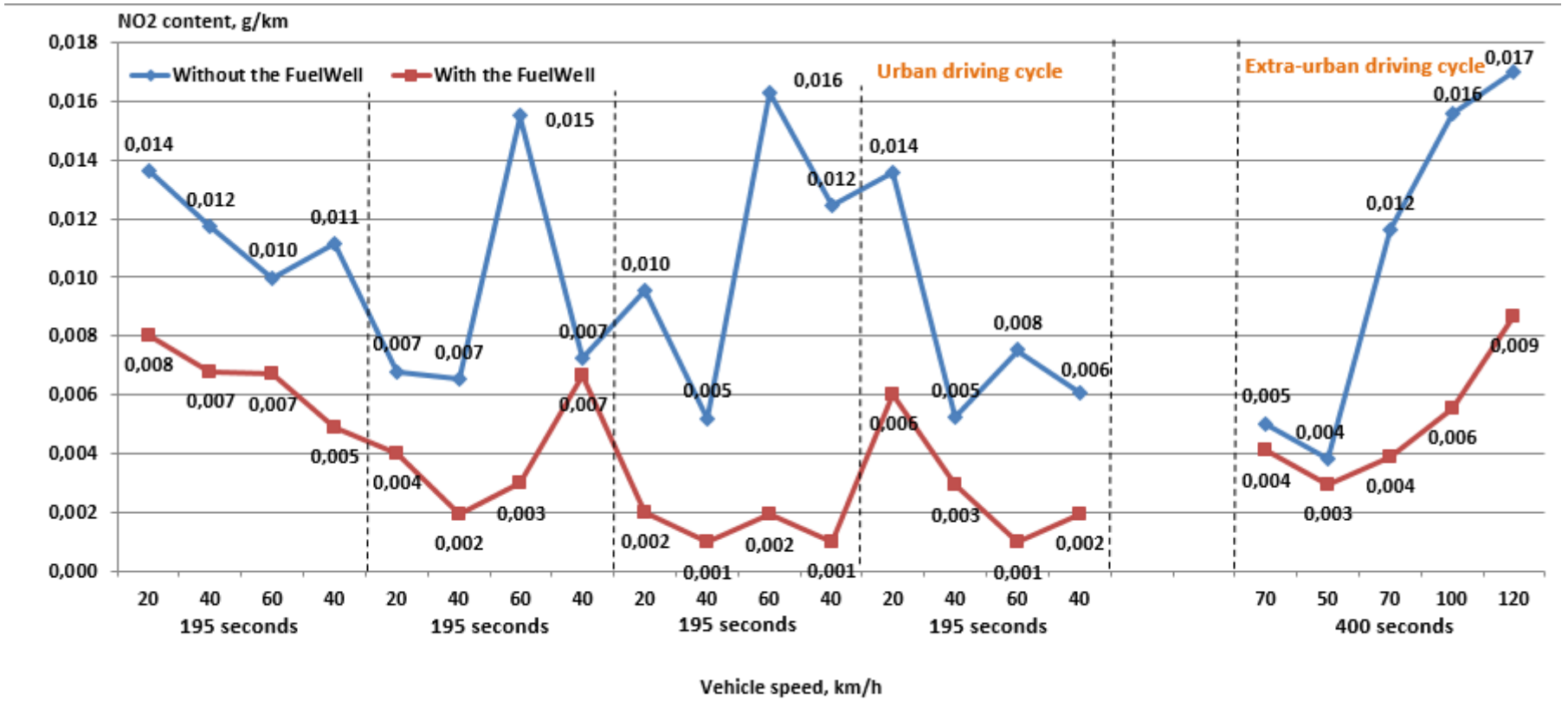

Fig. 3.4 – The content of nitrogen dioxide (NO_2) of the exhaust gases of the ICE

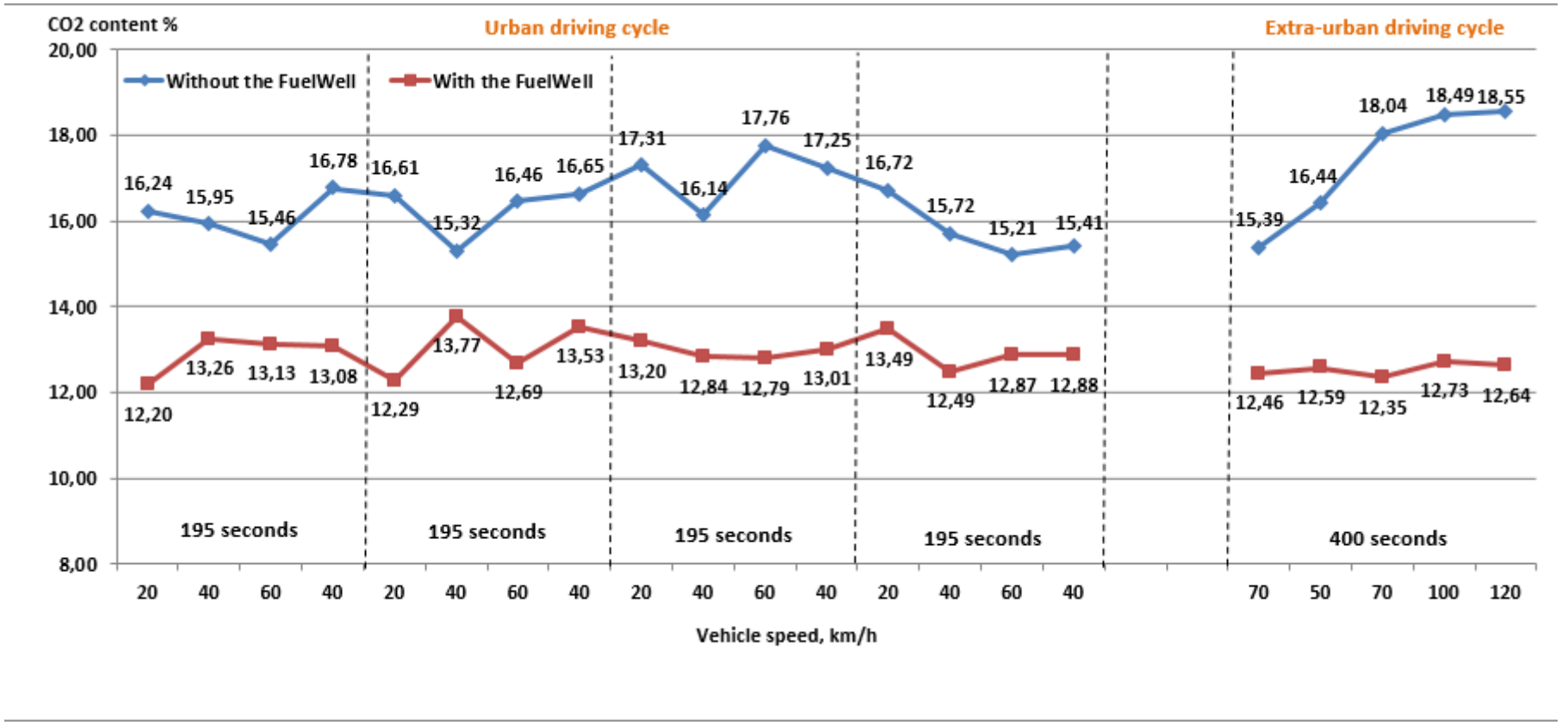

Fig. 3.5 – The content of carbon dioxide (CO_2) of the exhaust gases of the ICE

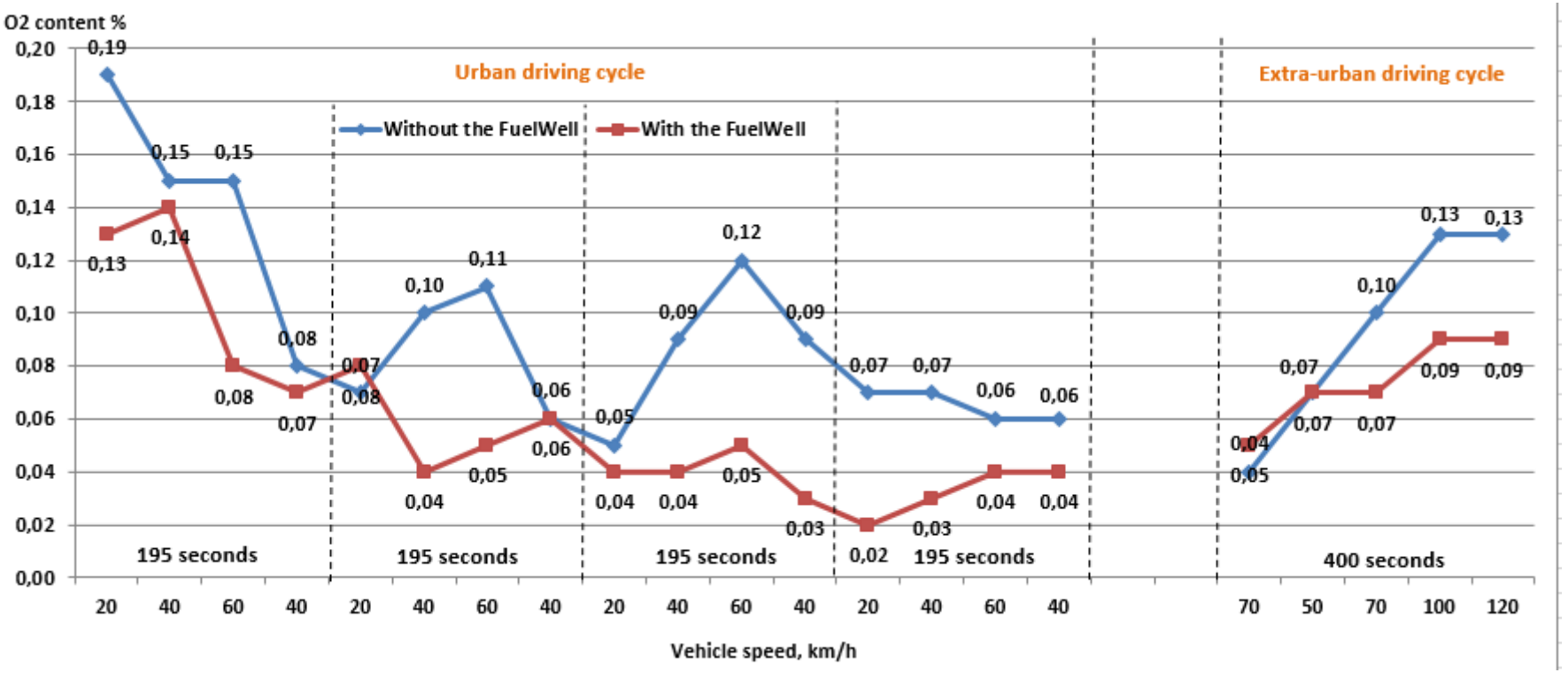

Fig. 3.6 – The content of oxygen (O_2) of the exhaust gases of the ICE

3.2 Analysis of the results of the measurements of the exhaust gas content of the internal combustion engine

The main environmental indicators of the work of automotive internal combustion engines are the content in the exhaust gases of nitrogen oxides (NOx) and carbon monoxide (CO).

During the measurement of the exhaust gas component of the ICE, the values of NOx and CO content of the exhaust gases without the FuelWell and its application are determined.

As shown on Figures 3.1 and 3.2 the use of FuelWell in the fuel system allows to reduce the CO content in the exhaust gases on average by 2,3 times (by 55 %), and NOx – by 1,9 times (by 43 %).

The using theFuelWell in the ICE's fuel system also allowed reducing carbon dioxide (CO_2) emissions on average by 1,3 times (by 22 %). As a result the content of CO_2 in the exhaust gases fell from 16,57 % to 12,87 % (Pic. 3.5).

The reduction of CO and NOx content in the exhaust gases of the ICE, as well as the specific fuel consumption as a result of FuelWell is given on the table 3.5.

The comparison of the results of the measurement of the exhaust gas content of the gasoline engine of internal combustion with the standards «Euro» for emissions of toxic substances is given on the table 3.6.

The table 3.5 – Reduction CO and NOx content in the exhaust gases of the ICE, as well as the specific fuel consumption as a result of using FuelWell

№	Speed of vehicle, km/h.	CO reduction		NOx reduction		Reduction of specific fuel consumption	
		g/km	%	g/km	%	l/100 km	%
Urban driving cycle							
1	20	4,04	64,76	0,30	13,88	2,26	26,25
2	40	2,68	45,11	0,91	35,74	2,17	25,68
3	60	2,33	42,72	1,02	30,86	1,89	23,19
4	40	3,69	54,50	1,12	42,98	1,65	20,70
5	20	4,32	65,38	0,66	34,92	2,25	26,16
6	40	1,54	29,00	1,53	49,31	2,19	25,86
7	60	3,77	58,37	1,67	36,19	1,91	23,38
8	40	3,12	46,87	1,05	33,79	1,65	20,70
9	20	4,10	56,15	2,39	64,72	2,27	26,33
10	40	3,31	53,84	2,34	53,44	2,15	25,50
11	60	4,97	64,05	3,21	62,18	1,93	23,57
12	40	4,24	58,49	2,90	63,45	1,65	20,70
13	20	3,24	48,15	1,99	63,57	2,23	25,99

14	40	3,23	56,40	0,99	39,45	2,19	25,86
15	60	2,34	44,88	0,60	18,92	1,92	23,47
16	40	2,54	46,83	1,01	34,56	1,64	20,60
Extra-urban driving cycle							
17	70	2,94	54,43	0,42	13,03	1,46	18,41
18	50	3,85	59,85	2,25	50,71	1,92	23,13
19	70	5,70	70,80	3,87	61,71	2,05	24,35
20	100	5,76	67,84	4,38	62,81	2,45	28,69
21	120	5,91	69,12	4,32	60,93	2,18	26,17

The table 3.6 – Comparison of the results of the measurement of the exhaust gas content of the gasoline ICE with Euro standards for emissions of toxic substances

Meaning	CO, g/km	NOx, g/km	Note
According to the measurement results (average meaning):			
• Without the FuelWell	6,57	3,85	
• With the FuelWell	2,87	2,0	
«Euro» standards (gasoline):			
• Euro III	2,30	0,15	
• Euro IV	1,00	0,08	
• Euro V	1,00	0,06	
• Euro VI	1,00	0,06	

Conclusion

One of the options to reduce the negative environmental impact of internal combustion engines of various vehicles is to use special device - FuelWell. The using of such device allows not only to reduce the content of harmful substances in exhaust gases, but also to reduce fuel consumption.

In order to measure the composition of the exhaust gases of the internal combustion engine and the specific fuel consumption, on August 15, 2017, a vehicle with the ICE, which was equipped with a device for reducing harmful emissions to the atmosphere and saving fuel FuelWell, was tested,.

Exhaust gas and specific fuel consumption measurements were performed on the Hyundai Elantra 1.6 (HD), which is equipped with Beijing Hyundai Motor Co. Petrol Diesel Vehicles. type G4FC. During the measurement, 100 MUSTANG gasoline was used to power the engine.

Measurements were made by simulating the movement of the vehicle using the DynoProject Dynamo Dynamic Dynamic Dynamic Model of the DP4L-Shnchro model using the NEDC technique. This technique involves simulating the vehicle in two cycles:

- urban driving cycle, at speed from 20 km/h to 60 km/h;
- extra-urban driving cycle, at speed from 50 km/h to 120 km/h.

The duration of the test cycle is 1220 seconds (4 tests for 195 seconds + 1 test for 400 seconds). The cycle length is 11007 meters. Average speed is 33.6 km / h. Maximum speed is120 km / h.

In order to evaluate the results obtained, the tests were conducted in two modes of operation of the ICE:

- Mode 1: without the FuelWell;
- Mode 2: with the FuelWell.

In each mode of operation of the ICE, the specific fuel consumption (l / 100 km) was fixed

During the measurement of the composition of the exhaust gases, the content of the following elements was recorded:

- oxygen (O_2);
- carbon dioxide (CO_2);
- nitrogen oxides (NOx: NO, NO_2);
- carbon monoxide (CO);
- sulfur oxide (SO_2).

Based on the results of measuring the composition of the exhaust gas of the ICE and the specific fuel consumption and comparing the results obtained for the two modes of the engine

(without and with the FuelWell), the following conclusions can be drawn.

According to the results an average content of CO of the exhaust gases was approximately 6,57 g/km without the FuelWell and 2,87 g/km with the FuelWell. This indicated a significant (about 55 %) reduction CO concentration in the exhaust gases.

Content of NOx of the exhaust gases of the ICE not equipped by the FuelWell was an average 3,85 g/km. Equipped ICE with the FuelWell allowed to reduce content of NOx in 2 times and reached an average indicators - 2,0 g/km.

Thus, using the FuelWell led to reduction in NOx by an average of 40 %. However, this value is slightly higher than median allowable value.

The results of measuring showed the oxygen content of the exhaust gases at the level 0,06…0,1 %, that does not exceed the limit values.

CO_2 content without the FuelWell of the exhaust gases was on average 16,57 % and 12,87 % with the FuelWell. Thus, using of the FuelWell in fuel supply of the ICE also allowed to reduce harmful emissions of CO_2 on average in 1,3 times (by 22 %).

During the measurement in the exhaust gases an insignificant content of sulfur oxide, at a level of 0,0018 %, was found to be below the permissible level.

Thus, the use of this device, which allows to reduce harmful emissions into the atmosphere and save fuel FuelWell has a positive flow to the engine fuel system, in particular in the specific fuel consumption and the content of harmful substances in the exhaust gases.

Equipped ICE fuel system by FuelWell allowed:

- reduced the content of carbon monoxide(CO) in the exhaust gases by 55 %;
- reduced the content of nitrogen oxides (NOx) in the exhaust emissions by 44 %;
- reduced the concentration of carbon dioxide (CO_2) in the exhaust gases by 22 %;
- reduced specific fuel consumption by 24 %.

According to the results of the measurements, in order to increase the profitability of gasoline combustion engines, as well as to reduce the negative environmental impact on the environment from their work, it is recommended to equip the ICE by the FuelWell - special device for reducing harmful emissions into the atmosphere and saving fuel.