VIAQ-12-10

Inter-laboratory interior air quality test results

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28-29.03.2018

Introduction (inter-laboratory test 1, 2014-2017)

The quantitative content of pollutants in the air of the passenger compartment is determined with using of gas analyzers working on the basis of the methods described in VIAQ-12-08.

It is important to establish how the results of on-line and stationary analysis are reproduced during of same test modes.

Only measurements of nitrogen oxide and dioxide were compared during these tests.

Quantitative measurements of carbon monoxide can be carried out only on-line, since it is always possible to select CO - analyzer with the required technical characteristics reliable in road conditions and having small dimensions, which is also an important factor.

Measurement data of nitrogen oxide and dioxide with using of on-line and stationary determination with preliminary air sampling in the bags are shown in Table 1.

Table 1. Measurement data of nitrogen oxide and dioxide with using of on-line and stationary determination with preliminary air sampling into the bags

Test vehicle	Test mode/ Fuel	Cate gory	Test date	NO, mg/m^3			NO_2, mg/m^3		
				On-line analysis, Re	Stationary analysis, R st	Relative difference of defi-nition,**. RDD,%	On-line analysis	Stationary analysis	Relative difference of definition,%
Vehicle 1	Idle/petrol	M1	2.04.2017	0,035	0,026	29,5	0,001	0,001	0,0
Vehicle 2	Idle/petrol	M1	3.04.2014	0,001	0,001	0,0	0,005	0,004	22,2
Vehicle 3	Idle/diesel	M1	4.04.2014	0,017	0,033	64,0	0,010	0,004	0,0
Vehicle 4	Idle/diesel	M1	07.04.2014	0,140	0,164	15,8	0,008	0,012	40,0
Vehicle 5	Idle/petrol	M1	08.04.2014	0,002	0,002 0,002(1	0,0	0,005	0,005 0,006(1	0,0
Vehicle 6	Idle/petrol	M1	9.04.2014	0,001	0,001	0,0	0,004	0,005	22,2
Vehicle 7	Idle/diesel	M1	10.04.2014	0,129	0,133	3,1	0,004	0,007	54,5

Test results

Table continuation

Test vehicle	Test mode/ Fuel	Cate- gory	Test date	NO, mg/m^3			NO_2, mg/m^3		
				On-line analysis, Re	Stationary analysis, Rst	Relative difference of defi- nition,**. RDD,%	On-line analysis	Stationary analysis	Relative difference of definition,%
Vehicle 10	Idle/petrol	M1	21.04.2014	0,010	0,013	26,1	0,014	0,017	19,4
Vehicle 11	Idle/diesel	M1	22.04.2014	0,087	0,081	7,1	0,001	0,002	66,7
Vehicle 12	Idle/petrol	N1	23.04.2014	0,005	0,001	133,3	0,022	0,032 0,025(1	37,0
Vehicle 13	Idle/petrol	M1	23.04.2014	0,007	0,007 0,011(1	0,0	0,001	0,001 0,001(1	0,0
Vehicle 14	Idle/petrol	M1	5.06.2014	0,005	0,001	133,3	0,002	0,004	66,7
Vehicle 15	Idle/diesel	M1	30.05.2014	0,012	0,019	45,4	0,276	0,270	2,2

Test results

End of Table

Test vehicle	Test mode/ Fuel	Cate-gory	Test date	NO, mg/m^3			NO_2, mg/m^3		
				On-line analysis, Re	Stationary analysis, Rst	Relative difference of defi-nition,**. RDD,%	On-line analysis	Stationary analysis	Relative difference of definition,%
Vehicle 18	Idle/petrol V-50km/h	M1	21.10.2014	0,012 0,001	0,010 0,005	18,2 133,3	0,024 0,032	0,019 0,024	23,3 28,6
Vehicle 19	Idle/petrol	M1	7.11.2014	0,051	0,045	12,5	0,012	0,012	0,0
Vehicle 20	Idle/petrol V-50km/h	M1G	23.10.2014	0,094 0,002	0,090 0,002	4,3 0,0	0,061 0,063	0,051 0,060	17,9 4,9

Note . * The average reading of the measured component in 20 minutes, mg/m^3 ;

(1- the result of measurement from the bag after storage of the sample during 24 h, mg/m^3);

** Relative difference of definition RDD= (Re – Rst)/((Re+Rst)/2).

Conclusion (inter-laboratory test 1, 2014-2017)

As can be seen, in the course of long-term tests conducted during 2014, a good convergence of quantitative measurements of nitrogen oxides was achieved with using both on-line and stationary measurements. When the relative difference in measurements, exceeded 25%, the compared results were of the same order (0.004 and 0.007, 0.005 and 0.001; 0.001 and 0.002, etc.) mg/m^3.

Introduction (inter-laboratory test 2, 2018)

The nitrogen oxides emissions of 2 category M1 test cars with gasoline and diesel engines were determined during several modes (idling, movement with different speeds and acceleration) at different positions of the ventilation system and are shown in Tables 2 and 3.

The inter laboratory reproducibility of measurement results of chemiluminescent analyzers P-310A and CLD-60 was evaluated at on-line in this work.

The readings of gas analyzers R 310A and CLD60 were taken during on-line measurements when these MT was at the board of test vehicles.

Test results

Table 2. Comparison the results of measurements nitrogen oxide and dioxide obtained during on-line analysis . Test vehicle category M1, diesel engine. Test date 5 February

Test modes	Position of ventilation system	NO, mg/m³		NO2, mg/m³	
		Model of gas analyzer		Model of gas analyzer	
		R 310A	CLD 60	R 310A	CLD 60
Idling	Recirculaton OFF Ventilation ON	0,254	0,244	0,012	0,014
	Recirculaton ON Ventilation OFF	0,236	0,380	0,003	0,005
V – 50 km/h	Recirculaton OFF Ventilation ON	0,003	0,006	0,003	0,006
	Recirculaton ON Ventilation OFF	0,003	0,004	0,003	0,004
V – 90 km/h	Recirculaton OFF Ventilation ON	0,001	0,003	0,003	0,006
	Recirculation ON Ventilation OFF	0,003	0,004	0,003	0,006
Acceleration up to 130 m/h, down to 60 km/h	Recirculation OFF Ventilation ON	0,001	0,008	0,003	0,007
	Recirculation ON Ventilation OFF	0,006	0,003	0,005	0,002

Test results

Table 3. Comparison the results of measurements of nitrogen oxide and dioxide during on-line analysis. Test vehicle category M1, gasoline engine. Test date 6 February

Test modes	Position of ventilation system	NO, mg/m^3		NO_2, mg/m^3	
		Model of gas analyzer		Model of gas analyzer	
		R 310A	CLD 60	R 310A	CLD 60
Idling	Recirculation OFF Ventilation ON	0,029	0,030	0,003	0,004
	Recirculation ON Ventilation OFF	0,044	0,047	0,003	0,006
V – 50 km/h	Recirculation OFF Ventilation ON	0,003	0,005	0,003	0,004
	Recirculation ON Ventilation OFF	0,007	0,010	0,003	0,004
V – 90 km/h	Recirculation OFF Ventilation ON	0,003	0,007	0,003	0,003
	Recirculation ON Ventilation OFF	0,011	0,012	0,003	0,004
Acceleration up to 130 km/h, down to 60 km/h	Recirculation ON Ventilation OFF	0,015	0,011	0,004	0,002
	Recirculation ON Ventilation OFF	0,029	0,017	0,003	0,004

Technical characteristics of gas analyzers R-310A and Eco-Physics CLD-60 are shown in Table 4.

Table 4 Technical characteristics of gas analyzers R-310A and Eco-Physics CLD-60

Technical parameters	R-310A (OPTEC), Russia	CLD-60, Eco-Physics, Swiss
Detector	Chemilumiscent (geterogenic type)	Chemilumiscent (convertor type)
Destination	Measuring of NO, NO_2 in ambient atmospheric air	Measuring of NO, NO_2 in ambient atmospheric air
Nominal resolution of LCD display	0,001 mg/m^3 (0,001 ppm)	0,0005 mg/m^3 (0,0005 ppm)
The limit of allowable main error (reduced, relative)	±25%	There is no concept of “main measurement error” in international practice
Limits of the readings allowable variation	±0,5 parts of main error	-
Discreteness of the analysis (change of indications on the display)	180 s	1 s
Power consumption	400 VA	250 VA
Weight	12 kg	16 kg (excl. Pump)
Time for analyzer indication setting	Does not exceed 6 min	Approx. 20 min
Supply voltage	230 V, 50 Gz	24 V

Conclusion (inter-laboratory test 2, 2018)

The good convergence of measurement results was achieved at these test regimes during the tests as can be seen from the tables. And even when the relative measurement difference was more than 25%, the comparable results were also at the same order (0.003 and 0.006, 0.015 and 0.021, 0.005 and 0.002 mg/m^3, etc.).
This allows to use the various models of gas analyzers with the same detectors and the measurement methods, both on-line and in a stationary state with preliminary sampling into the bags.

Thank you for your attention!