Contents of Work Package 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

Coordinator of the WP

České vysoké učení technické v Praze, Vojtěch Klír

Participants of the WP

VUT v Brně, J. Fišer, M.Omasta, Univerzita Pardubice, P. Voltr, ŠKODA AUTO a. s., J. Hrnčíř, M. Klofec, J. Hradiský, TUV SÜD Czech, J. Trubač, Tribotec, spol. s r.o., P. Rosendorf, Škoda Transportation, P. Špalek

Main Goal of the WP

Complex coverage of the issue of particles generated by the car, trains and their monitoring. Particles generated by brakes + tires, emissions from powertrains = emissions. Particles in the environment / surroundings of the vehicle + technologies for their measurement at the vehicle level, their penetration into the cabin, exposure for humans in the crew space = immissions of particles, their measurement and mitigation of their effects on human health.

Partial Goals for the Current Period

Use of knowledge for the construction of systems for removing particles/aerosols from the environment for the crew.

Critical review about possible solution for future combustion engines. Test bench for particle measurements – design.

Development of experimental approaches towards the knowledge base for the R&D of materials and technologies for low-emission rail transport while focusing on non-exhaust emissions.

Contents of Work Package 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

Official 3-WP08 Deliverables:

- 3-WP08-001: **Engine control strategy and aftertreatment setup toward EU7 limits fulfillment**, G-funk, V./2026, CVUT FME 0.6; SA 0.3; TÜV SÜD 0.1
- 3-WP08-002: **Test bench for particle measurements**, G-funk, V./2026, CTU FME 0.4; TÜV SÜD 0.3; SA 0.3
- 3-WP08-003: **Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study**, O – ostatní výsledky, XII./2025, BUT FME 0.7 , CTU FME 0.1, SA 0.2
- 3-WP08-004: **Description of vehicle emission behavior in the lab. and under real driving conditions - methods and procedures for measurement in context of regenerative braking systems**, O – ostatní výsledky, XII./2024, CTU FME 0.5; BUT FME 0.2; TÜV SÜD 0.1; SA ost. 0.2
- 3-WP08-005: **Device for an evaluation of particulate matter emissions from railway sanding (ZV)**,G-funk, XII./2024, BUT 0.65; TRIBT 0.2; ŠTRN 0.1; UPa 0.05
- 3-WP08-006: **Research on the traction enhancers and technologies towards low non-exhaust emissions**, O – ostatní výsledky, G-funk, VI./2026, BUT 0.65; TRIBT 0.2; ŠTRN 0.1; UPa 0.05

Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08-001: Engine control strategy and aftertreatment setup toward EU7 limits fulfillment

CVUT FME 0.6; SA 0.3; TÜV SÜD 0.1

Monitoring & obtaining knowledge from EU7 proposal (still running).
Critical review about possible solution for future combustion engines.
Euro7 – RDE CF=1 for NOx and PN
Particles from braking in mg/km PM10 per test cycle (4.5 hour, WLTP, 303 x brake decelaration events)

Úřední věstník Evropské unie — CS Řada L

2024/1257 — 8.5.2024

NAŘÍZENÍ EVROPSKÉHO PARLAMENTU A RADY (EU) 2024/1257

ze dne 24. dubna 2024

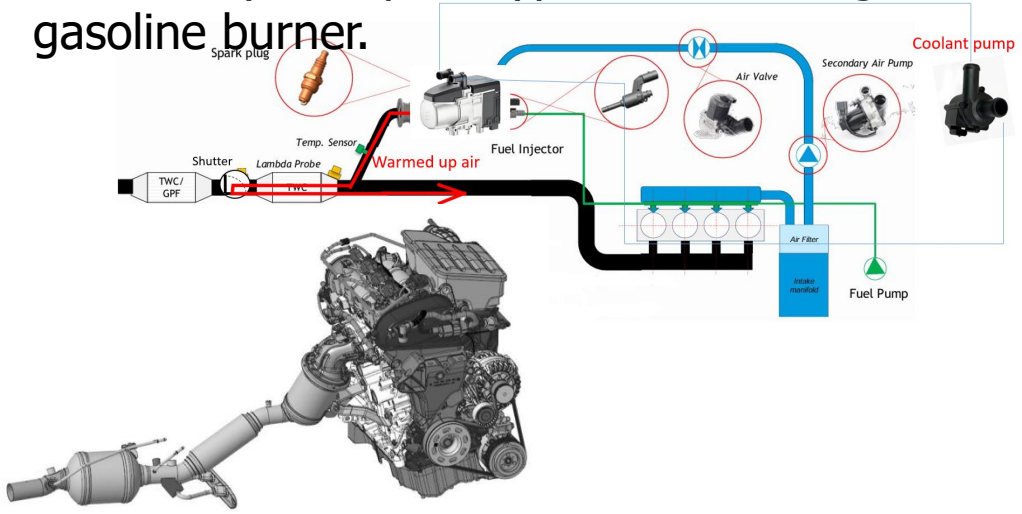
o schvalování typu motorových vozidel a motorů, jakož i systémů, konstrukčních částí a samostatných technických celků určených pro tato vozidla z hlediska jejich emisí a životnosti baterie (Euro 7), o změně nařízení Evropského parlamentu a Rady (EU) 2018/858 a o zrušení nařízení Evropského parlamentu a Rady (ES) č. 715/2007 a (ES) č. 595/2009, nařízení Komise (EU) č. 582/2011, (EU) 2017/1151 a (EU) 2017/2400 a prováděcího nařízení Komise (EU) 2022/1362

Tabulka 1: Mezní hodnoty výfukových emisí Euro 7 pro vozidla kategorií M_1 a N_1 se spalovacím motorem

		Hmotnost v provozním stavu (MRO) (kg)	Hmotnost oxidu uhelnatého (CO)		Celková hmotnost uhlovodíků (THC)		Hmotnost nemetanových uhlovodíků (NMHC)		Hmotnost oxidů dusíku (NOx)		Součet celkové hmotnosti uhlovodíků a hmotnosti oxidů dusíku (THC + NOx)		Hmotnost částic (PM)		Počet částic (PN_{10})	
			L_1 (mg/km)		L_2 (mg/km)		L_3 (mg/km)		L_4 (mg/km)		$L_2 + L_4$ (mg/km)		L_5 (mg/km)		L_6 (#/km)	
Kategorie	Třída		PI	CI	PI	CI	PI	CI	PI	CI	PI	CI	PI	CI	PI	CI
M_1	—		1 000	500	100	—	68	—	60	80	—	170	4,5	4,5	$6x10^{11}$	$6x10^{11}$
N_1	I	MRO ≤ 1280	1 000	500	100	—	68	—	60	80	—	170	4,5	4,5	$6x10^{11}$	$6x10^{11}$
	II	1280 < MRO ≤ 1735	1 810	630	130	—	90	—	75	105	—	195	4,5	4,5	$6x10^{11}$	$6x10^{11}$
	III	1735 < MRO	2 270	740	160	—	108	—	82	125	—	215	4,5	4,5	$6x10^{11}$	$6x10^{11}$

Poznámka: PI = zážehový motor.
CI = vznětový motor.

Exhaust System prototype with an integrated gasoline burner.

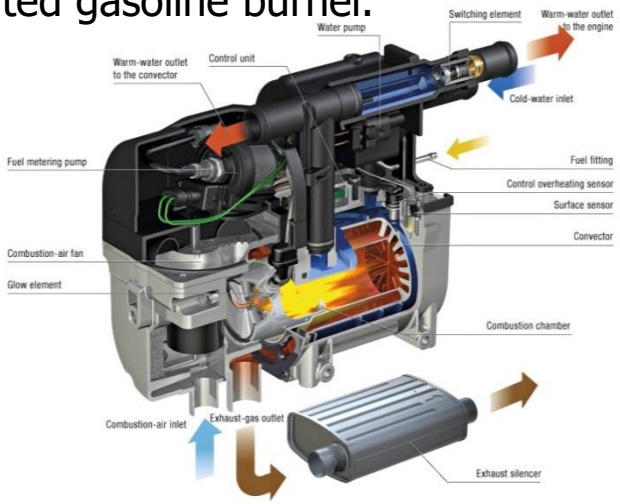


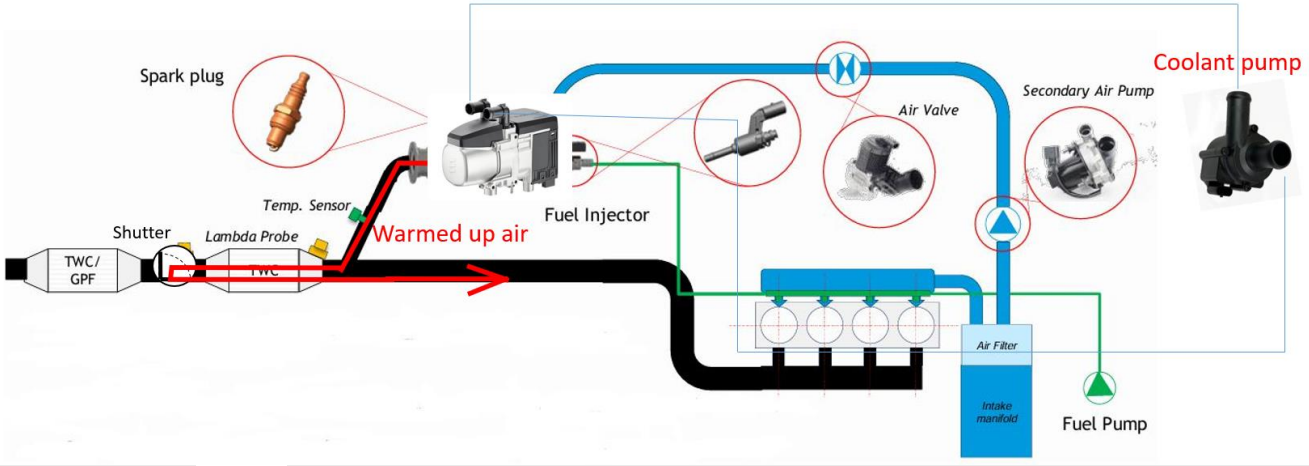
Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

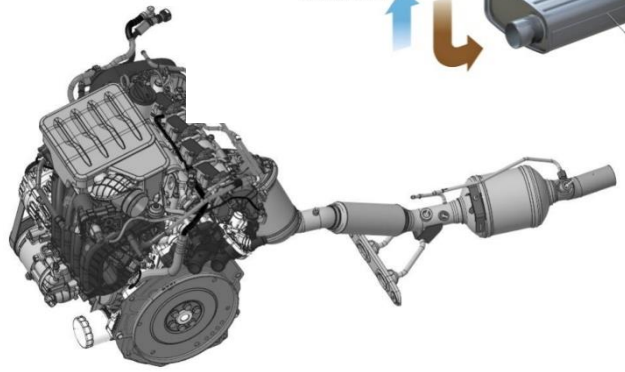
3-WP08-001: Engine control strategy and aftertreatment setup toward EU7 limits fulfillment

CVUT FME 0.6; SA 0.3; TÜV SÜD 0.1

Next step: to make an Exhaust System prototype to test the EU7 emissions with an integrated gasoline burner.
Engine from ŠA (Skoda 1,5L) with the serial exhaust was adopted.
Parts to get for the instrumentation:
-Burner (Webasto heater)
-Accessories
-The sheet metal and the pipes will be design and made







Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

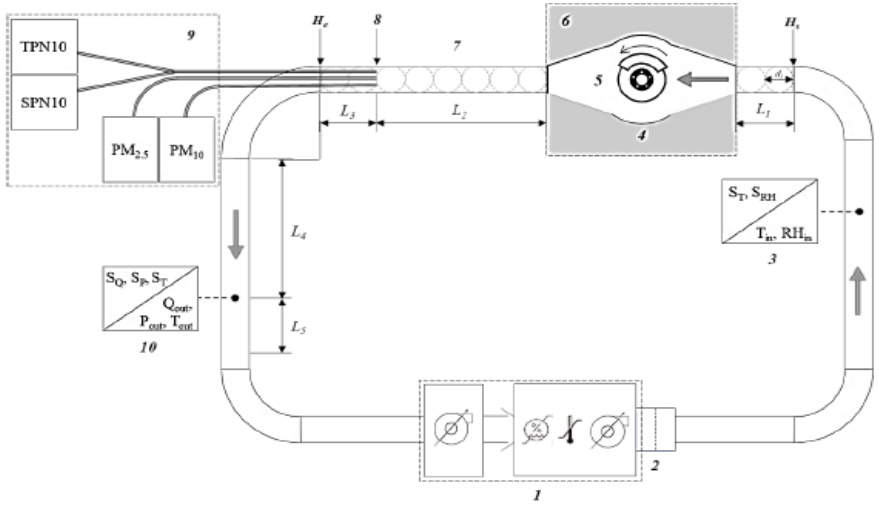
3-WP08-002: Test bench for particle measurements

CTU FME 0.4; TÜV SÜD 0.3; SA 0.3

Test design definition – concept related to HW and SW solution.

3D model appropriate for manufacturing.

Manufacturing of keys parts for prototype.



Indicative layout

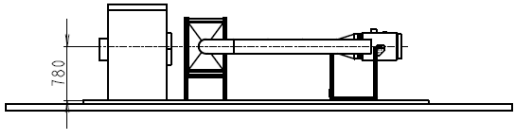
Tabulka 4: Mezní hodnoty emisí částic z brzd Euro 7 při standardním jízdním cyklu platné do 31. prosince 2029, podle technologie hnacího ústrojí

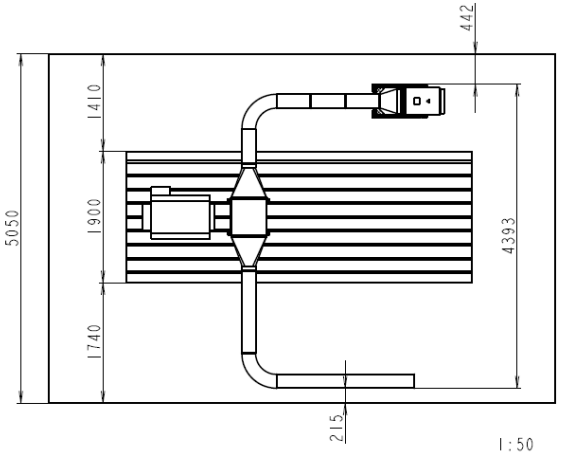
Mezní hodnoty emisí v mg/km na vozidlo	Vozidla kategorií M_1 a N_1, kromě vozidel kategorie N_1 třídy III (*)				
Technologie hnacího ústrojí	PEV	OVC-HEV	NOVC-HEV	FCV/FCHV	ICEV
Emise částic z brzd (PM_{10})	3	7	7	7	7

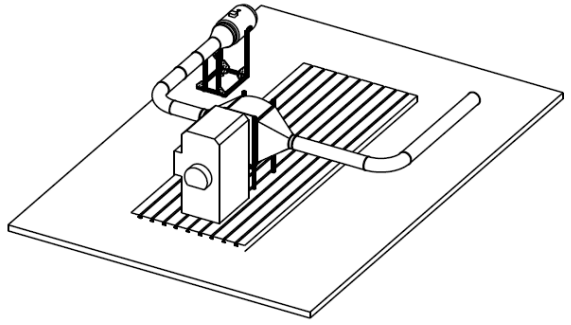
(*) Pro vozidla kategorie N_1 třídy III platí tyto mezní hodnoty: PEV 5 mg/km; OVC-HEV, NOVC-HEV, FCV/FCHV a ICEV 11 mg/km.

Tabulka 5: Mezní hodnoty emisí částic z brzd Euro 7 při standardním jízdním cyklu platné od 1. ledna 2030 v návaznosti na přezkum uvedený v čl. 18 odst. 5, podle technologie hnacího ústrojí (vozidla kategorií M_1 a N_1)

Mezní hodnoty emisí	Vozidla kategorií M_1 a N_1				
Technologie hnacího ústrojí	PEV	OVC-HEV	NOVC-HEV	FCV/FCHV	ICEV



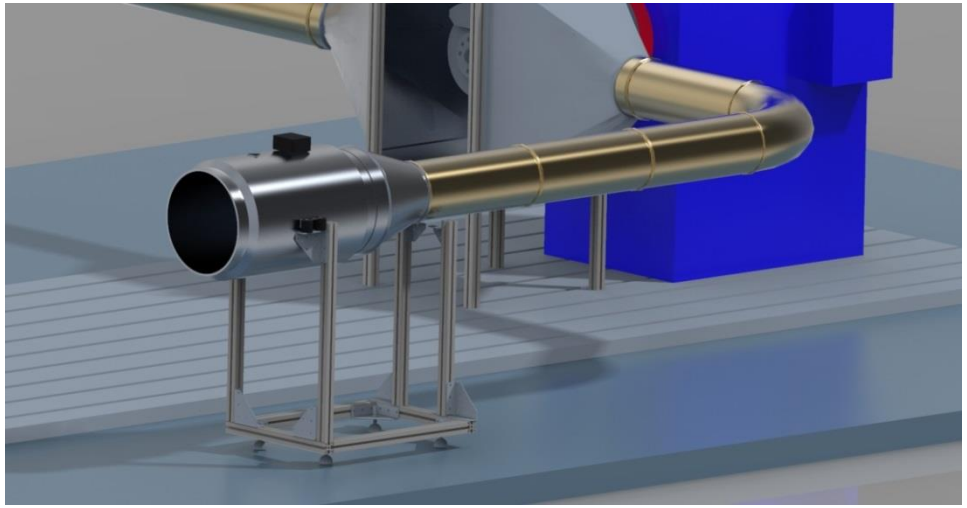




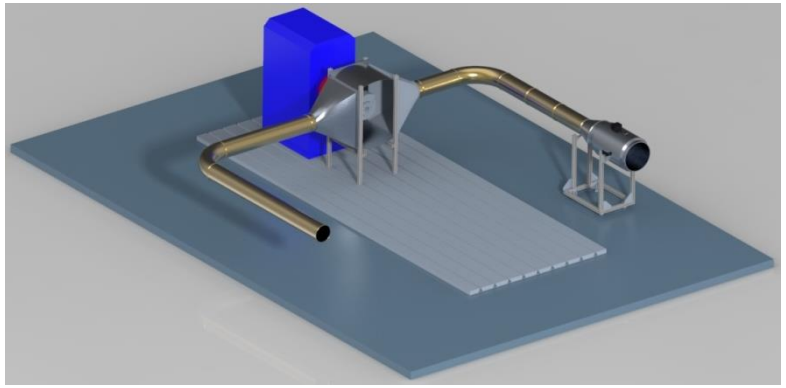
Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

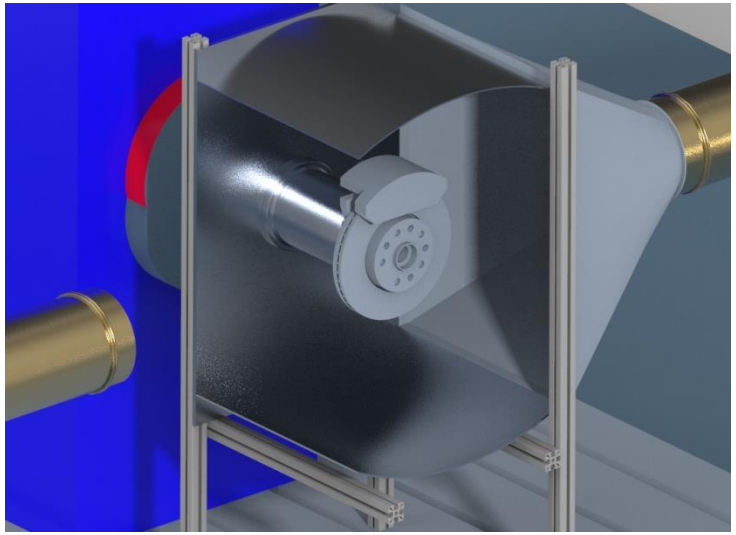
3-WP08-002: Test bench for particle measurements

CTU FME 0.4; TÜV SÜD 0.3; SA 0.3



Design and manufacturing

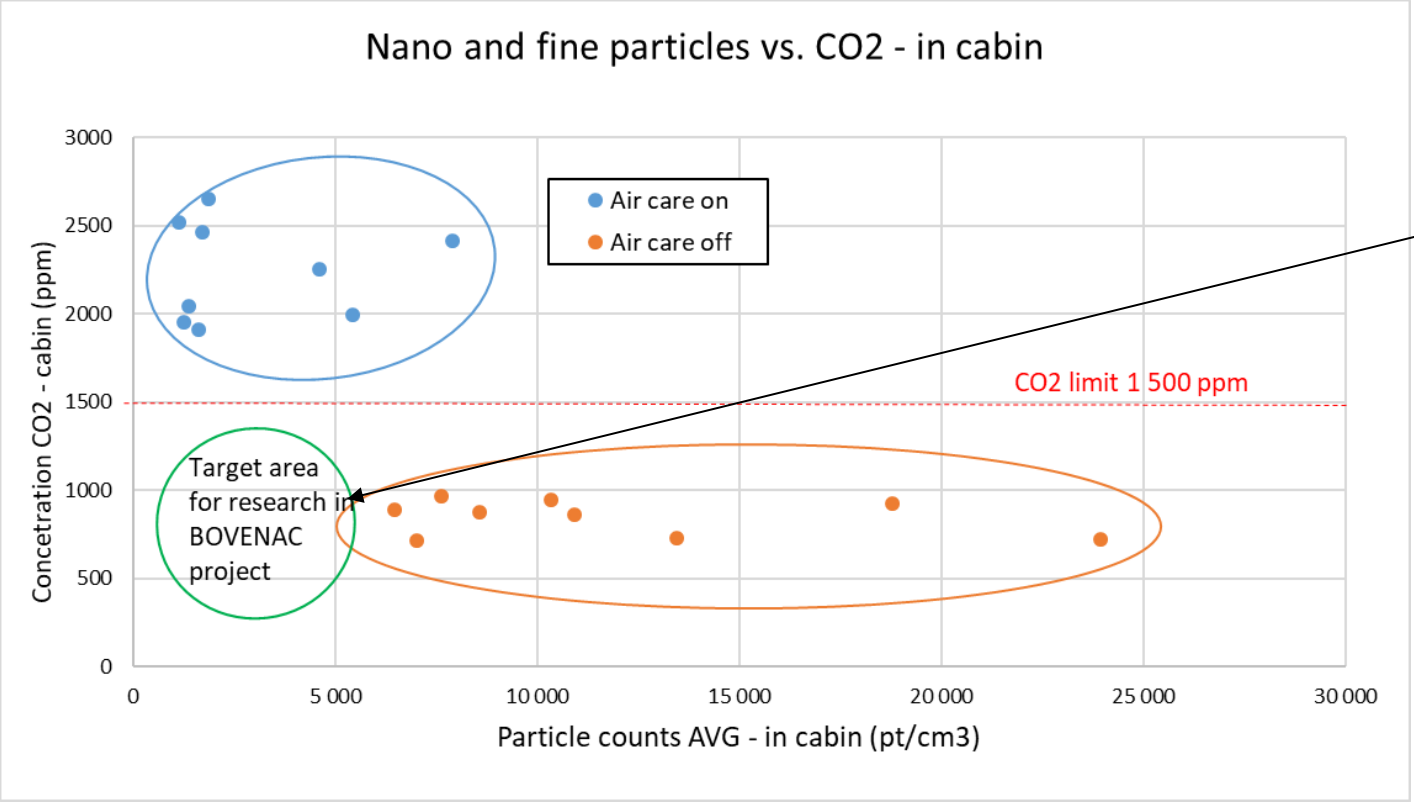




Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

Evaluation and feasibility study of improved systems for aerosol control in car cabin.



2023: Main target for research in 3-WP08:

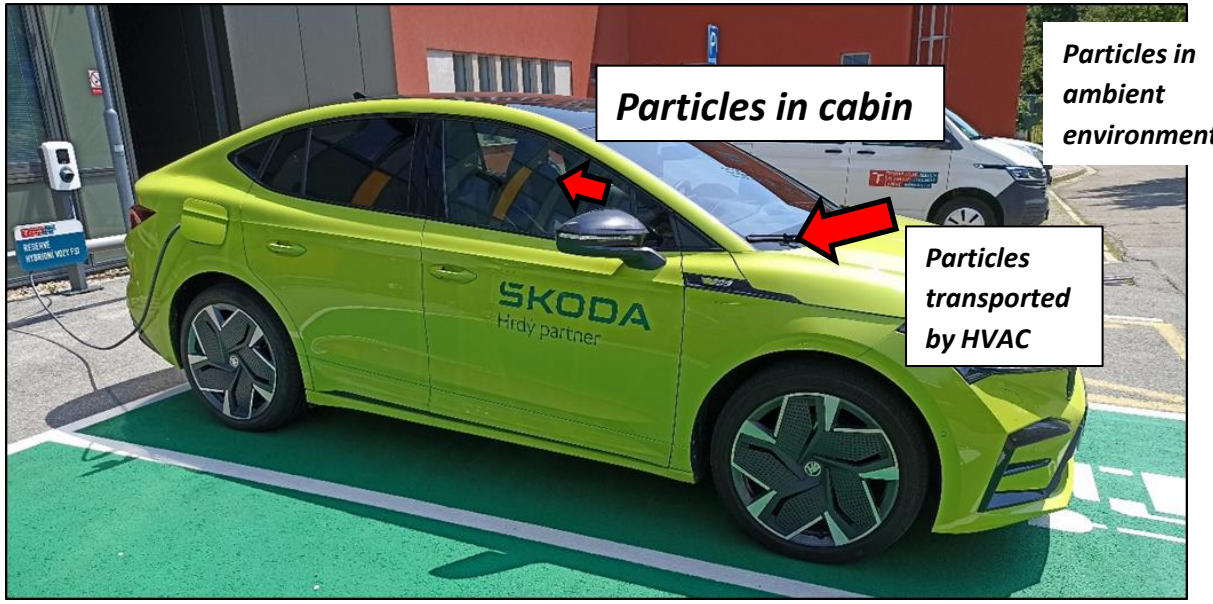
Good ventilation of cabin without fine particles

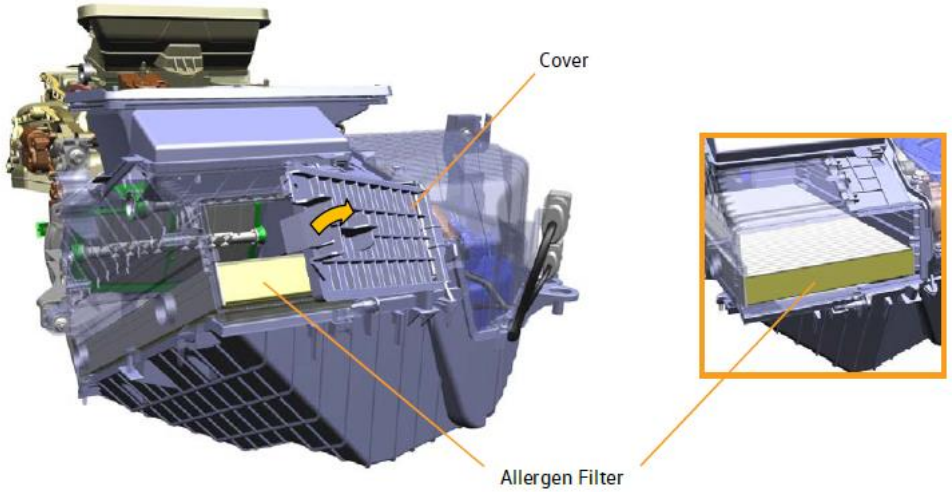
2024: Which technology is feasible?

Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

Evaluation and feasibility study of improved systems for aerosol control in car cabin.





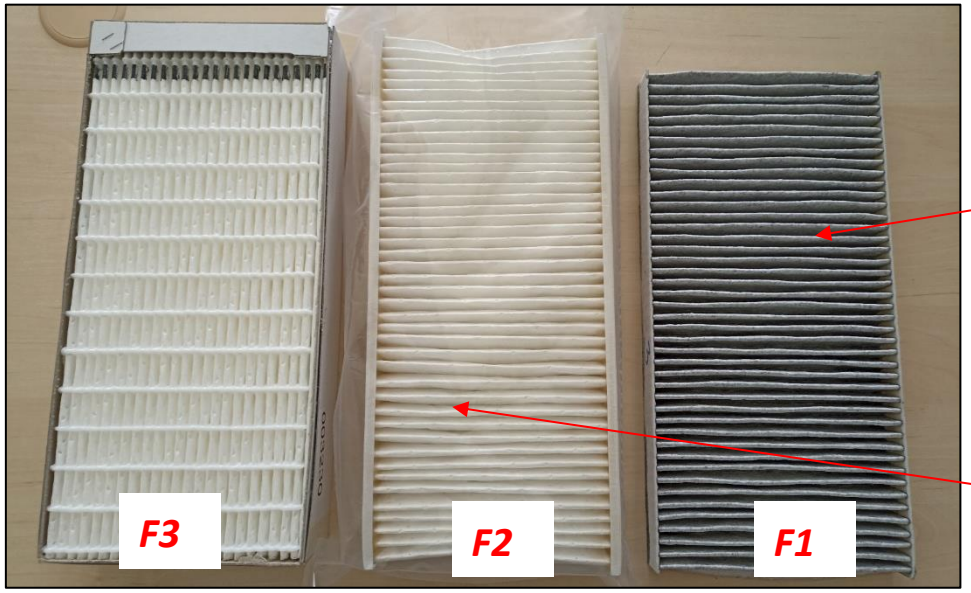
Main goal of research in 2024:

- To obtain data on particles (aerosols) entering the vehicle (MEB platform) from the surrounding environment (via the HVAC system).
- To compare concentrations in the surroundings of the vehicle and in the cabin of the **vehicle when using the upgraded filters**.
- Compare what the results are compared to previously conducted tests.

Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

Evaluation and feasibility study of improved systems for aerosol control in car cabin.



F1: classic filter

F2, F3: upgraded filters

Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

Evaluation and feasibility study of improved systems for aerosol control in car cabin.

Experiment environment: Urbanized area in Brno - highest pollution = stronger signal → results can be expected to be more conclusive

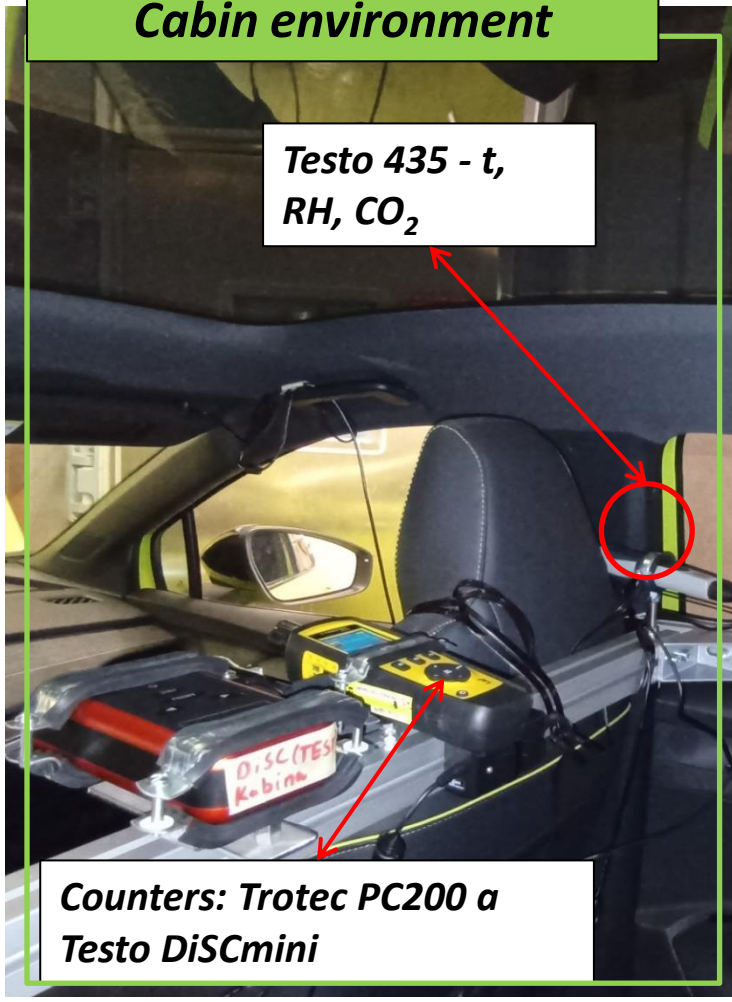
Summer – from 18.7. to 23.7.2024

HVAC setting: AUTO 22 + **AirCare off + fresh-air**

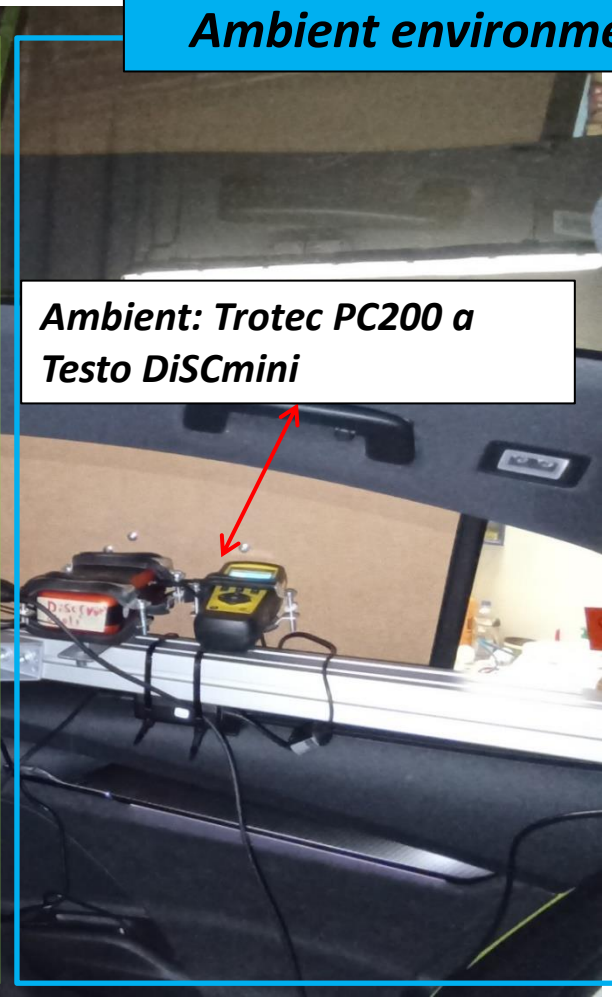
+ 3 types of filters

Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

Cabin environment



Ambient environment



Onboard camera NiceBOY

Probes inlet

Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

Evaluation and feasibility study of improved systems for aerosol control in car cabin.

TIME / AMBIENT ENVIRONMENT

Čas	Okruh	MÍSTO	Událost	Počasí	Trotec 1 OKOLÍ	Čas	Datum	0:00:00	PM 2.5 µg/m3	PM 10 µg/m3	0.3um počet	0.5um počet	1.0um počet	2.5um počet	5.0um počet	10 um počet	DiSCmini OKOLÍ čas	0-300 nm Počet	Velikost nm
					Pátek 19.7.2024														
7:54:10				jasno	město A, F1				2.3	15.8	12 237	4 274	780	205	61	39	7:54:10	3 500	72
7:55:17					město A				2.5	24.6	13 420	4 815	817	264	109	98	7:55:17	3 623	71
7:56:24					město A				2.3	15.8	14 079	5 365	628	202	62	44	7:56:24	4 865	65
7:57:31					město A				2.9	20.0	18 082	6 294	818	265	77	52	7:57:31	13 967	58
7:58:38					město A				2.9	20.2	14 347	5 346	978	276	77	37	7:58:38	5 853	59
7:59:45	Koridor nad Husovickým tunelem				město A				2.8	19.2	16 174	5 353	885	268	72	35	7:59:45	24 668	57
8:00:51					město A				9.4	35.6	52 878	18 957	2 930	524	103	48	8:00:52	321 729	26
8:01:58					město A				4.9	21.2	27 298	10 630	1 458	330	64	39	8:01:59	37 759	41
8:03:05					město A				3.0	20.1	14 150	5 935	963	282	75	46	8:03:06	11 072	50
8:04:12					město A				2.1	16.2	12 748	4 609	611	228	62	44	8:04:13	7 078	70
8:05:18					město A				3.1	30.7	17 004	5 649	1 013	332	136	88	8:05:20	10 690	53
8:06:25					město A				2.3	18.9	14 099	4 668	704	236	77	37	8:06:27	18 428	45
8:07:32					město A				5.3	39.1	22 606	9 604	1 843	502	155	104	8:07:34	13 906	53
8:08:38					město A				3.3	19.7	17 215	6 212	1 072	284	70	41	8:08:41	8 957	59
8:09:45					město A				3.6	24.8	18 334	6 936	1 157	348	93	71	8:09:48	11 706	54
8:10:52					město A				2.8	17.5	18 886	5 871	798	245	64	46	8:10:55	20 391	76
8:11:58					město A				5.7	28.9	29 435	10 764	1 894	425	96	67	8:12:02	49 150	79
8:13:05					město A				7.5	42.4	32 367	13 624	2 604	581	152	75	8:13:09	12 164	55
8:14:11					město A				6.3	48.8	28 386	11 173	2 202	690	187	125	8:14:16	30 784	62
8:15:18					město A				4.3	28.3	22 557	8 484	1 361	403	104	79	8:15:23	17 421	76
8:16:25					město A				3.4	18.8	18 616	7 148	1 033	288	63	41	8:16:30	17 243	52
8:17:31					město A				4.1	15.2	29 556	8 470	1 146	231	43	29	8:17:37	19 986	57
8:18:38					město A				3.1	15.0	17 005	6 107	967	222	49	27	8:18:44	11 907	68
8:19:44					město A				5.5	40.0	25 494	11 039	1 799	585	149	109	8:19:51	18 351	58
8:20:51					město A				3.1	28.8	16 100	6 244	969	331	124	69	8:20:58	15 261	50
8:21:58					město A				3.7	29.5	16 770	6 519	1 278	384	118	81	8:22:05	32 279	45
8:23:05	Stavba Baurova a Žabovřeská				město A				13.9	132.3	46 459	21 839	5 342	1 871	528	373	8:23:12	22 937	52
8:24:12					město A				16.5	127.8	72 432	30 174	5 714	1 689	505	354	8:24:19	79 107	42
8:25:18					město A				6.3	64.2	23 019	10 481	2 350	732	281	178	8:25:26	14 378	47
8:26:25					město A				14.8	129.7	58 254	27 456	5 213	1 656	532	396	8:26:33	120 807	30
8:27:32					město A				12.1	100.2	51 162	22 330	4 220	1 260	409	262	8:27:40	131 019	23
8:28:38	Kolona v Pisáreckém podjezdu				město A				10.5	56.8	48 576	21 786	3 374	840	193	119	8:28:47	156 626	27
8:29:45					město A				5.3	29.0	27 327	10 728	1 690	434	98	65	8:29:54	47 946	33
8:30:52					město A				6.1	34.7	32 165	12 895	1 875	512	120	54	8:31:01	32 765	42
8:31:59					město A				5.6	32.4	27 463	11 353	1 777	436	118	67	8:32:08	39 336	43
8:33:06					město A				17.5	123.5	69 691	30 283	6 360	1 717	467	283	8:33:15	64 513	35
8:34:13					město A				5.2	22.3	28 833	11 030	1 555	341	68	50	8:34:22	82 118	31
8:35:20					město A				2.8	16.7	14 165	5 594	924	243	59	41	8:35:29	22 412	41
8:36:27					město A				2.8	14.6	15 572	5 390	922	198	51	29	8:36:36	22 465	56
8:37:34					město A				2.7	15.4	12 229	4 839	942	197	57	46	8:37:43	4 897	61
					AVG				5.6	38.9	26 680	10 657	1 874	526	148	97		39 602	52
					SMODCH				4.0	33.5	15 454	7 053	1 464	447	136	95		57 216	14

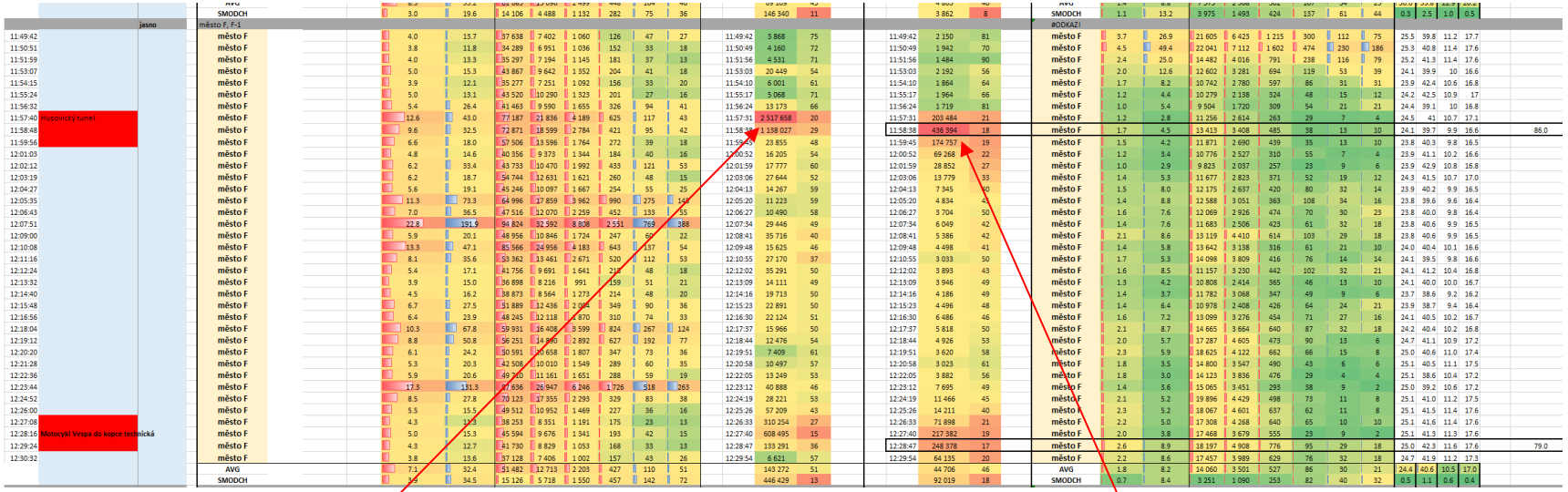
CABIN

DiSCmini - KABINA čas	0-300 nm Počet	Velikost nm	Trotec 3 KABINA	PM 2.5 µg/m3	PM 10 µg/m3	0.3um počet	0.5um počet	1.0um počet	2.5um počet	5.0um počet	10 um počet	AT °C	RH %	DP °C	WB °C
7:54:10	2 832	52	město A, F-1	4.2	57.5	13 960	5 890	1 657	571	272	210	22.3	60.3	14.1	17.6
7:55:17	2 702	49	město A	1.9	26.4	8 298	2 628	747	258	125	100	22.1	54.3	12.4	16.7
7:56:24	3 773	44	město A	1.3	9.8	5 943	1 814	471	88	44	33	22.1	49.6	11.1	16.2
7:57:31	3 253	45	město A	1.0	12.1	5 772	1 643	367	112	57	39	22.2	47.3	10.6	16.0
7:58:38	3 773	43	město A	0.8	8.1	5 560	1 647	236	87	36	25	22.4	45.7	10.3	16.0
7:59:45	4 246	42	město A	0.9	6.1	5 376	1 535	292	79	24	21	22.6	45.1	10.3	16.1
8:00:52	57 457	22	město A	3.3	45.5	10 429	4 257	1 368	474	212	172	22.7	47.8	11.2	16.5
8:01:59	51 491	23	město A	5.4	83.1	14 216	6 471	2 305	793	401	268	22.9	55.2	13.4	17.5
8:03:06	22 778	25	město A	3.6	46.9	9 639	4 077	1 591	441	223	157	23.0	53.3	12.9	17.3
8:04:13	10 167	29	město A	2.4	36.2	8 193	2 810	1 030	370	171	123	23.2	52.5	12.9	17.4
8:05:20	6 201	35	město A	1.4	14.9	6 138	2 189	543	139	69	44	23.3	48.8	12.0	17.1
8:06:27	5 726	35	město A	0.8	11.0	4 884	1 402	260	111	52	27	23.2	46.7	11.3	16.7
8:07:34	5 502	35	město A	0.8	4.1	5 012	1 457	282	48	15	8	23.2	56.0	13.8	17.8
8:08:41	4 426	39	město A	1.7	15.5	6 378	2 537	656	167	68	50	23.3	53.0	13.2	17.5
8:09:48	4 232	41	město A	0.7	5.3	4 473	1 313	205	56	23	16	23.2	50.1	12.3	17.1
8:10:55	5 437	48	město A	1.0	5.9	5 381	1 720	343	67	23	16	23.5	51.3	12.9	17.5
8:12:02	8 682	53	město A	1.4	19.2	7 347	2 142	530	232	85	56	23.4	46.7	11.5	16.9
8:13:09	7 190	52	město A	1.1	6.7	5 875	2 070	357	81	26	23	23.1	46.0	11.0	16.6
8:14:16	8 169	49	město A	1.3	6.6	7 291	1 871	494	69	25	18	23.2	45.4	10.9	16.6
8:15:23	9 501	53	město A	1.1	4.8	6 238	1 608	399	37	19	16	23.4	45.3	11.1	16.7
8:16:30	7 019	46	město A	0.9	9.1	6 977	1 846	267	76	43	29	23.6	44.7	11.1	16.8
8:17:37	7 110	44	město A	1.3	11.4	6 834	2 059	447	107	52	41	23.7	44.6	11.1	16.9
8:18:44	6 101	45	město A	1.2	15.2	7 582	2 019	407	152	71	60	23.8	44.7	11.3	17.0
8:19:51	5 419	45	město A	1.0	8.2	5 300	1 817	339	84	36	25	23.9	45.6	11.6	17.1
8:20:58	6 569	41	město A	1.3	12.5	6 961	1 865	454	156	53	35	23.9	46.7	11.9	17.3
8:22:05	6 327	40	město A	1.7	21.8	6 840	2 317	671	203	104	67	23.8	46.9	11.9	17.2
8:23:12	6 408	41	město A	1.7	14.5	7 313	2 360	681	128	66	52	24.0	47.4	12.2	17.4
8:24:19	12 328	40	město A	2.1	11.0	9 907	3 304	751	113	43	18	24.1	48.9	12.8	17.7
8:25:26	9 196	39	město A	1.4	8.2	9 240	2 459	477	94	32	18	24.1	48.0	12.5	17.6
8:26:33	17 002	32	město A	1.0	5.6	7 424	2 006	259	89	19	12	24.1	47.8	12.4	17.6
8:27:40	32 388	26	město A	2.0	12.6	9 753	2 974	757	119	53	35	24.2	47.0	12.3	17.5
8:28:47	49 928	24	město A	2.1	6.2	11 356	3 181	729	112	13	10	24.2	46.8	12.2	17.5
8:29:54	36 043	26	město A	1.8	10.3	10 206	3 102	616	127	39	21	24.4	46.1	12.2	17.6
8:31:01	21 233	32	město A	1.8	10.3	10 097	3 245	625	114	40	18	24.4	46.4	12.3	17.6
8:32:08	15 127	35	město A	1.1	4.2	8 832	2 408	292	37	15	8	24.4	45.4	12.0	17.5
8:33:15	19 539	32	město A	1.8	6.7	10 112	3 545	589	100	19	12	24.5	44.7	11.9	17.5
8:34:22	21 837	29	město A	1.2	7.1	7 985	2 457	374	76	28	25	24.6	44.5	11.9	17.6
8:35:29	15 131	28	město A	0.9	1.8	5 308	1 467	325	27	2	2	24.6	44.1	11.8	17.5
8:36:36	10 746	32	město A	0.8	3.3	5 195	1 568	258	24	13	10	24.6	45.1	12.1	17.6
8:37:43	6 257	39	město A	0.9	8.6	5 372	1 459	284	93	38	27	24.6	46.1	12.4	17.7
	13 481	38	AVG	1.6	15.4	7 625	2 463	593	158	69	49	23.5	48.0	12.0	17.2
	13 610	9	SMODCH	1.0	16.4	2 321	1 105	430	156	79	57	0.7	3.6	0.9	0.5

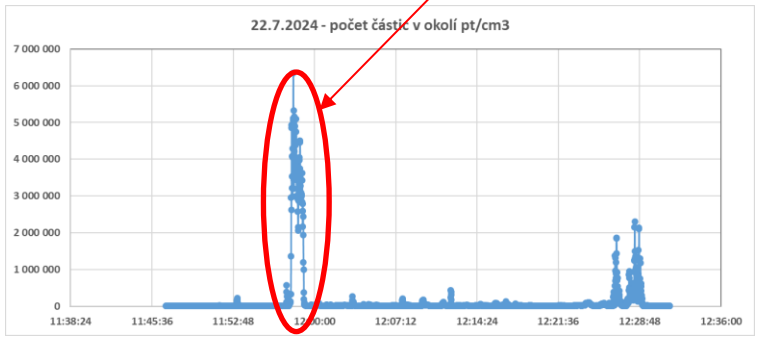
Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

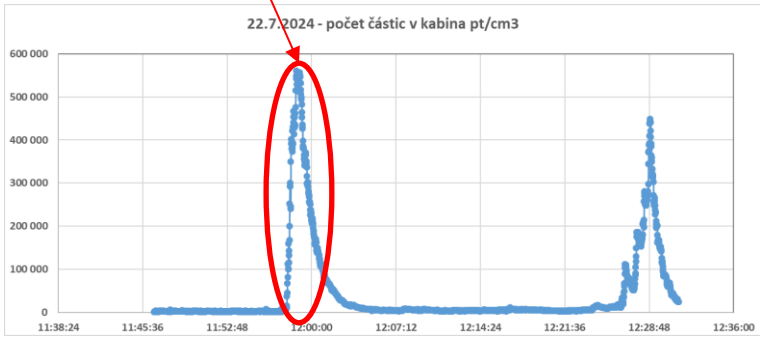
3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

Evaluation and feasibility study of improved systems for aerosol control in car cabin.



Dust event – example, Monday 22.7. – Kr. pole tunnel – Filter F1

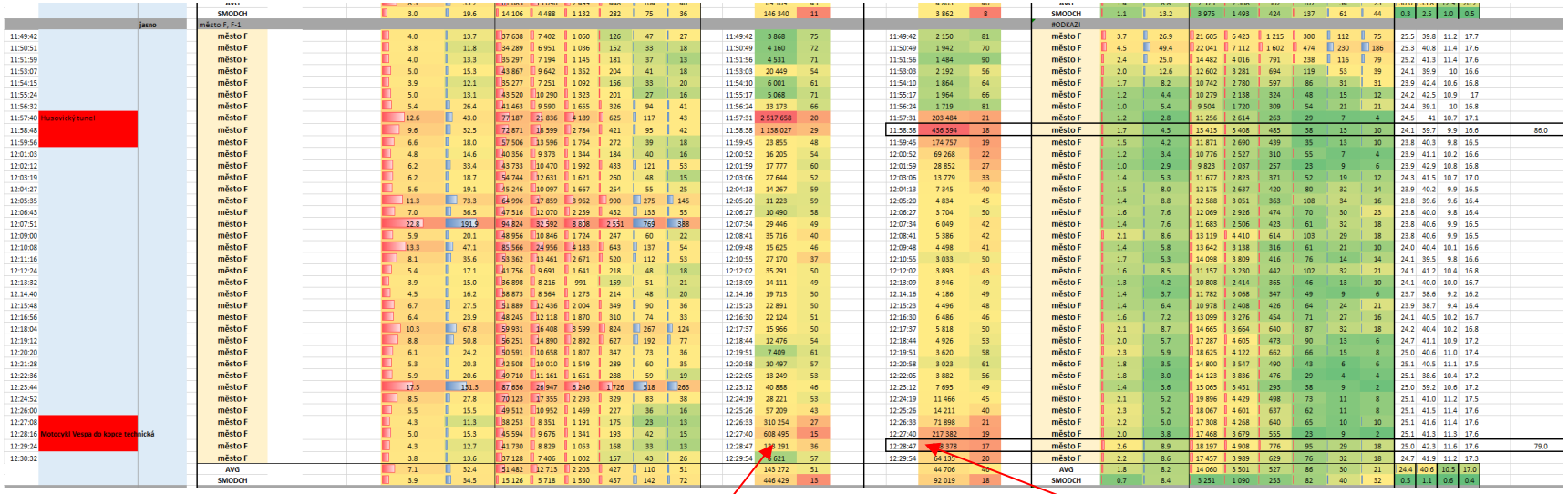




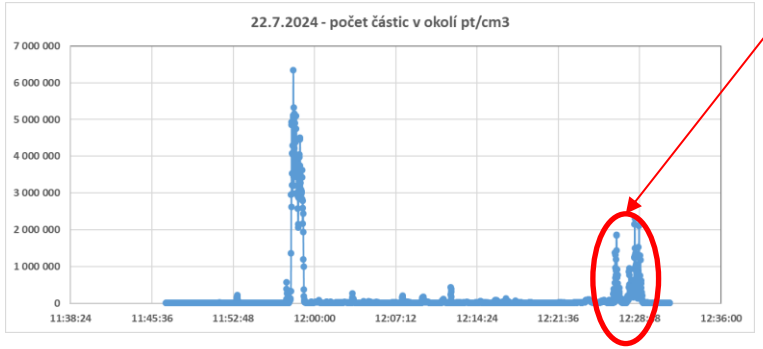
Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

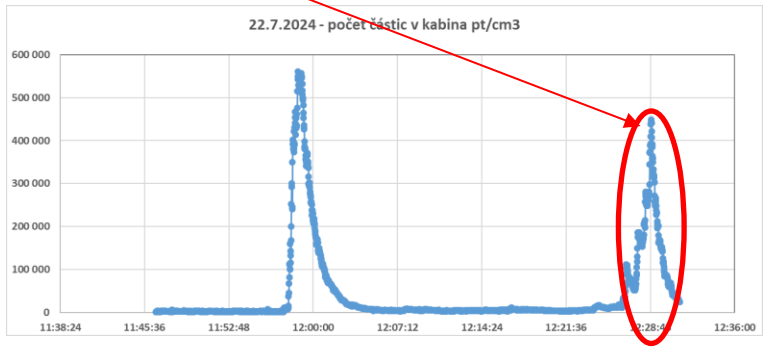
3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

Evaluation and feasibility study of improved systems for aerosol control in car cabin.



Dust event – example, Monday 22.7. – motorcycle Vespa – Filter F1

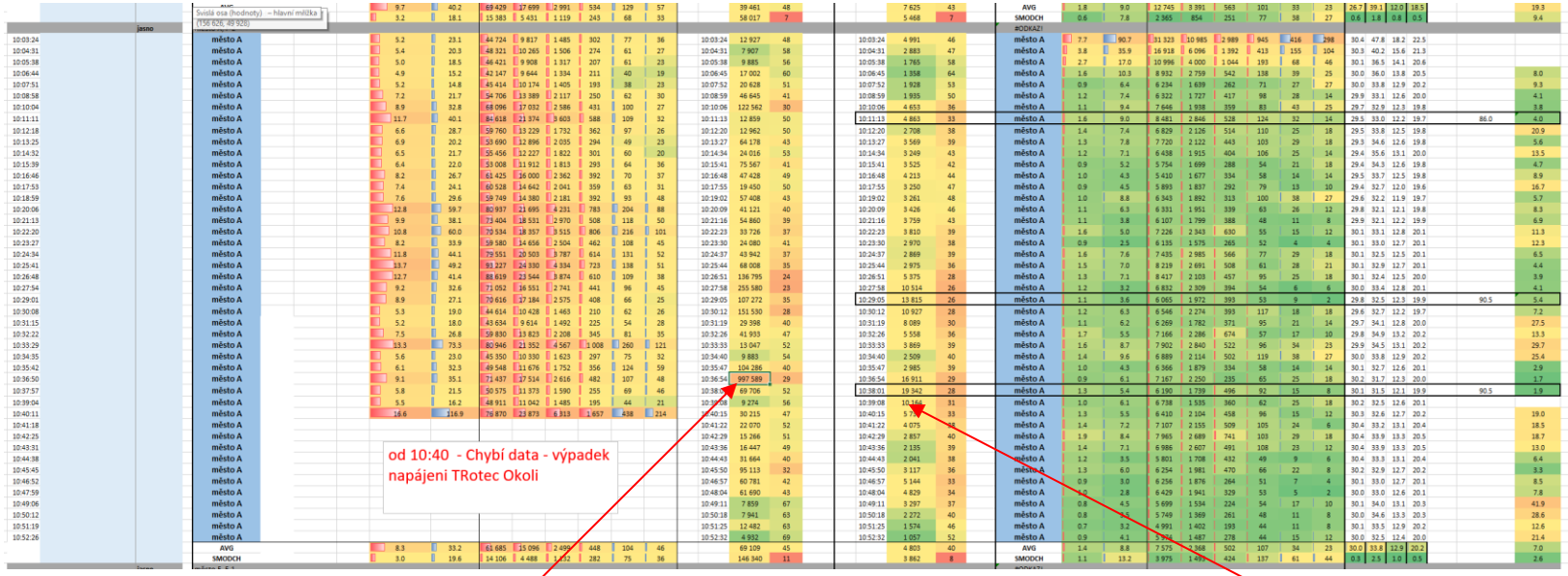


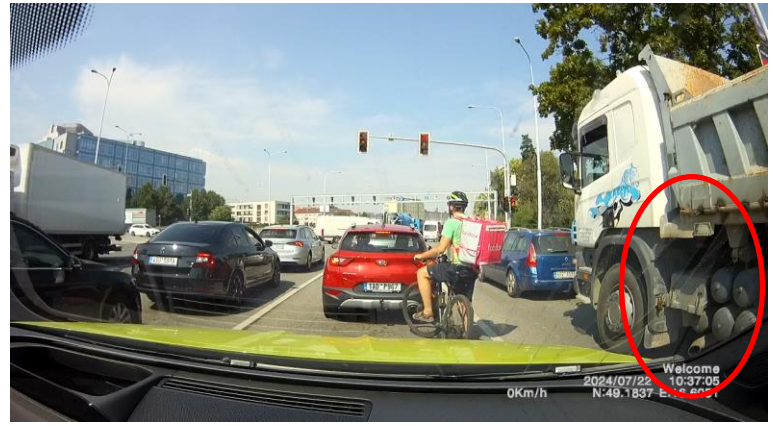


Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

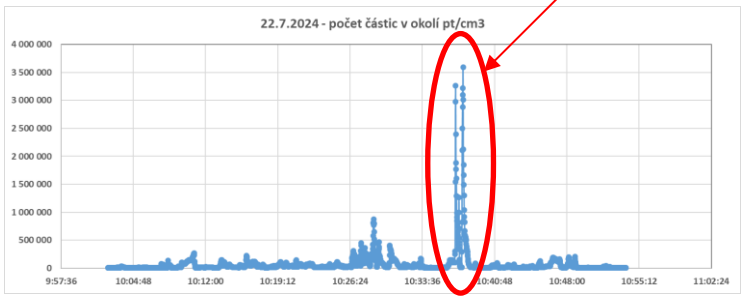
3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

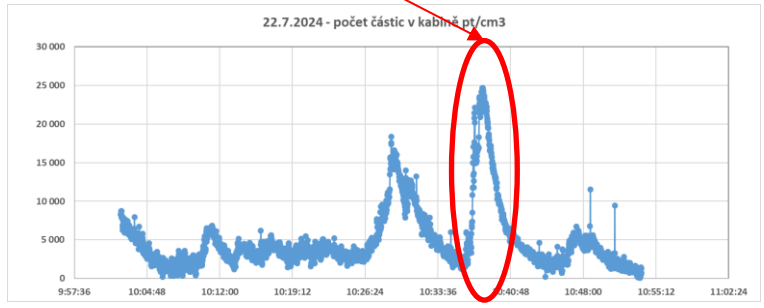
Evaluation and feasibility study of improved systems for aerosol control in car cabin.





Dust event – example, Monday 22.7. – heavy truck – Filter F2

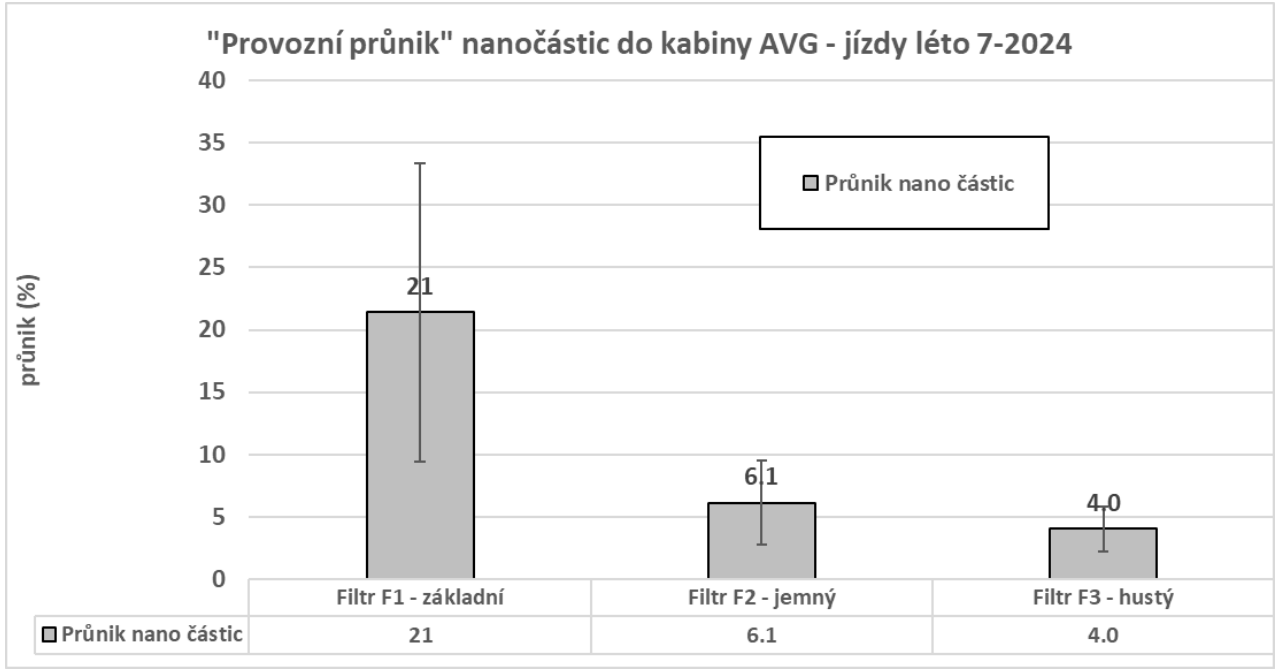


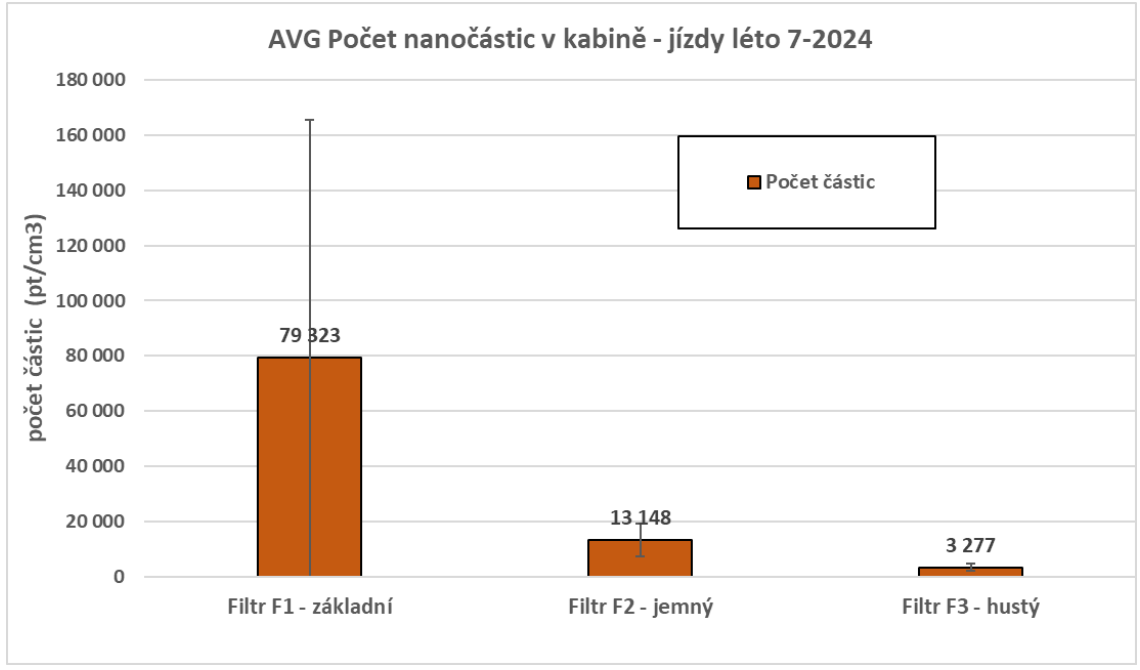


Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

Evaluation and feasibility study of improved systems for aerosol control in car cabin.

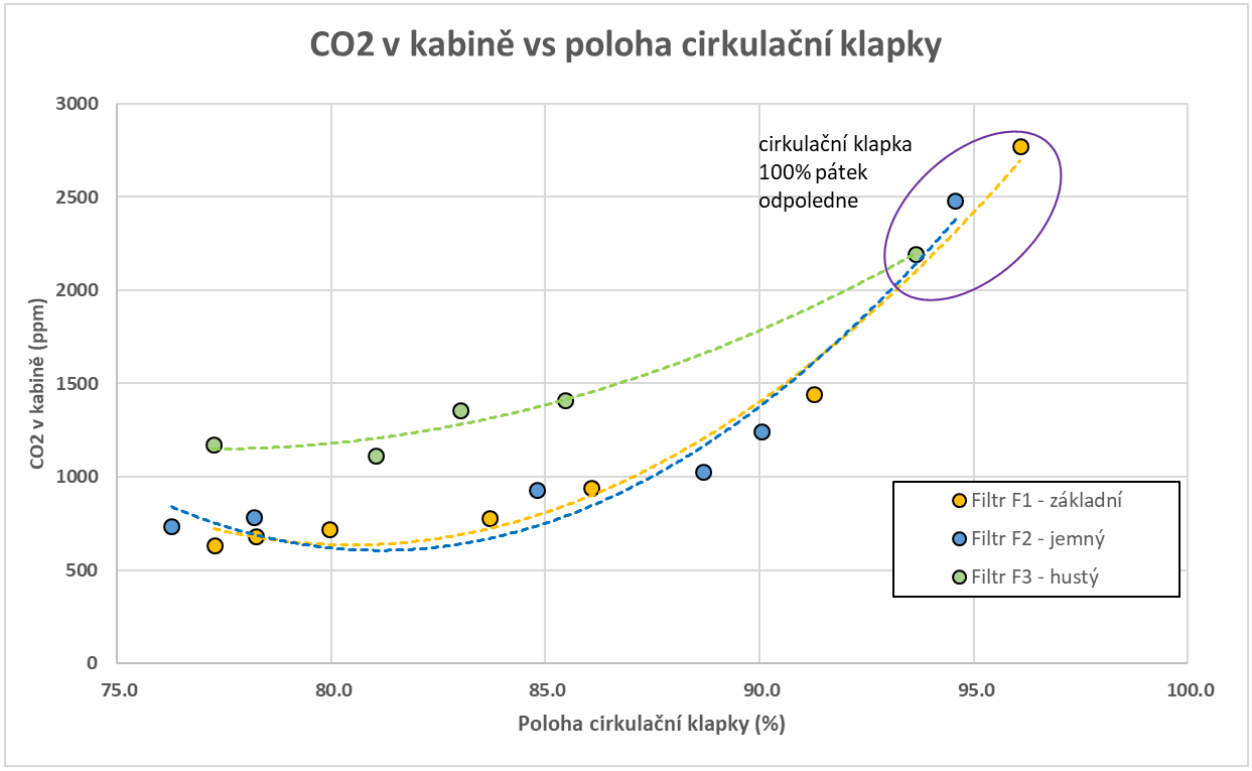


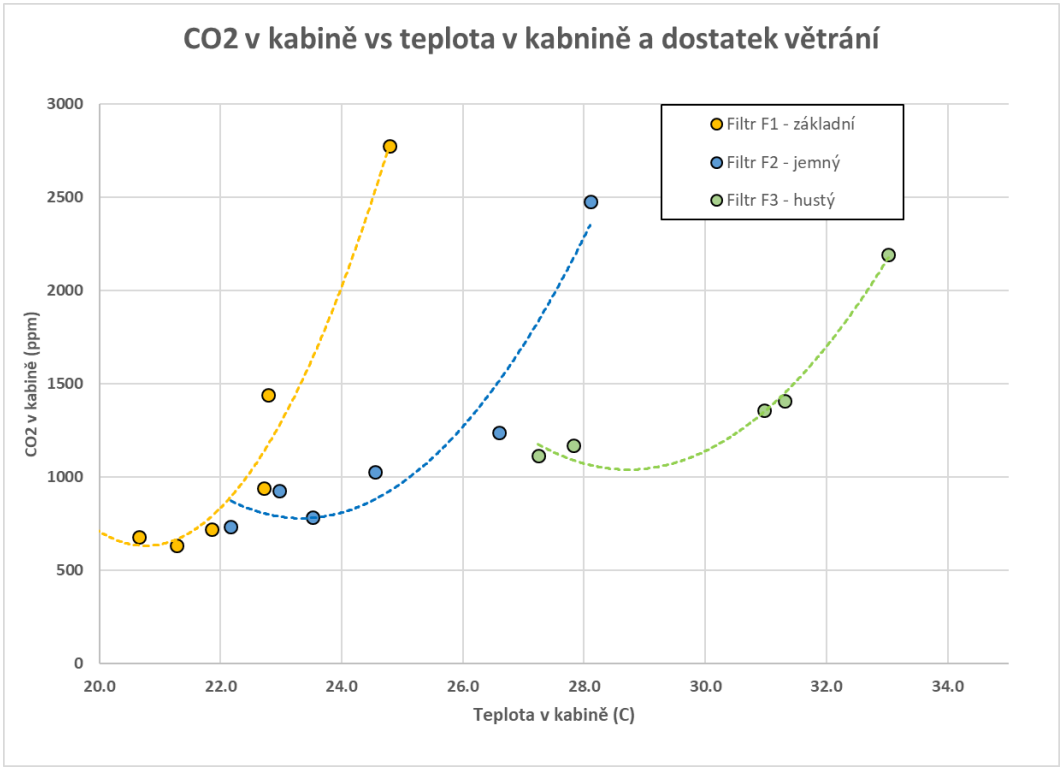


Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

Evaluation and feasibility study of improved systems for aerosol control in car cabin.

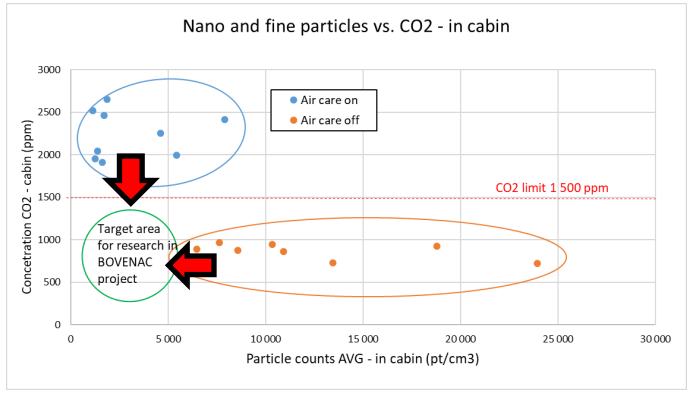




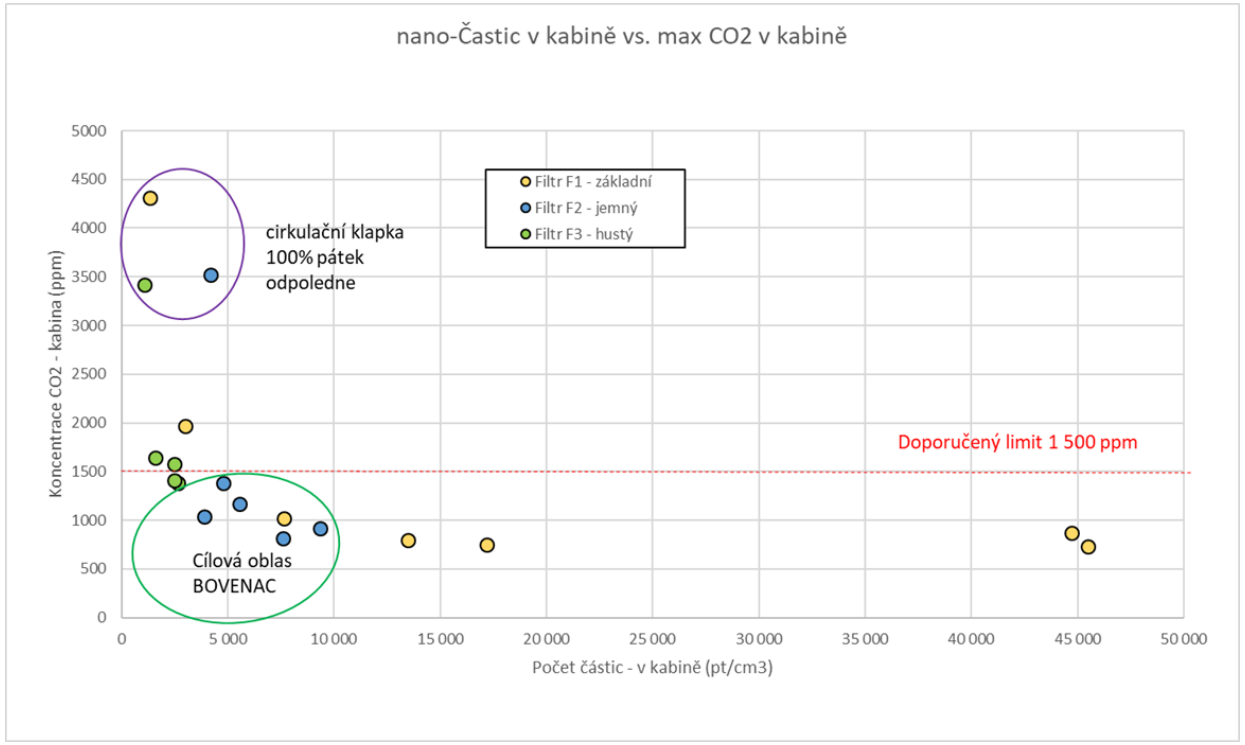
Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08-003: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study

Evaluation and feasibility study of improved systems for aerosol control in car cabin.



Target defined in 2023



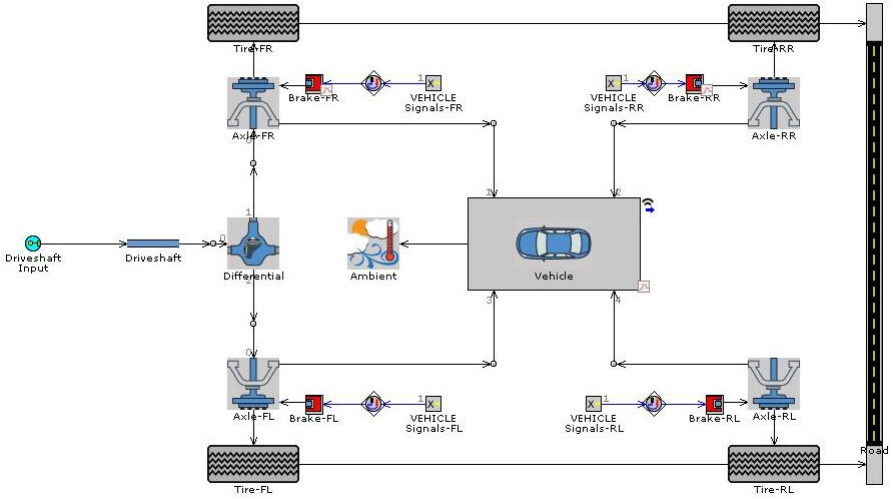
Results 2024

Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

3-WP08-004: Description of vehicle emission behavior in the lab. and under real driving conditions - methods and procedures for measurement in context of regenerative braking

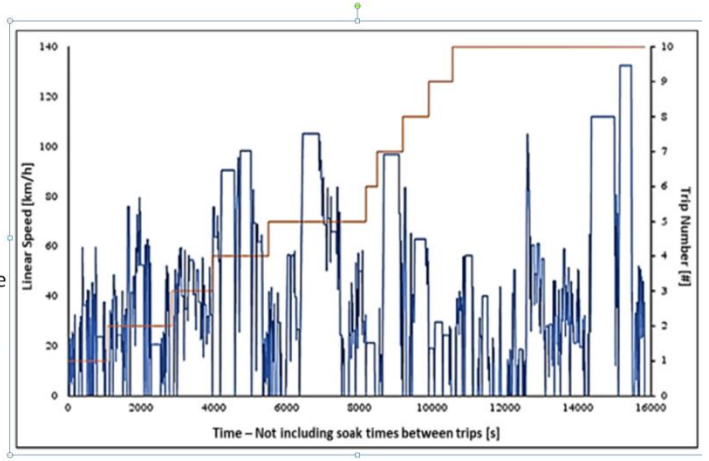
CTU FME 0.5; BUT FME 0.2; TÜV SÜD 0.1; SA ost. 0.2

- Chassis dyno testing - different degree of vehicle powertrain hybridization
- Data collection for prepared database
- Preparation for validation tests related to WLTP brake cycle
- GT-SUITE model – prediction of distribution of braking torque



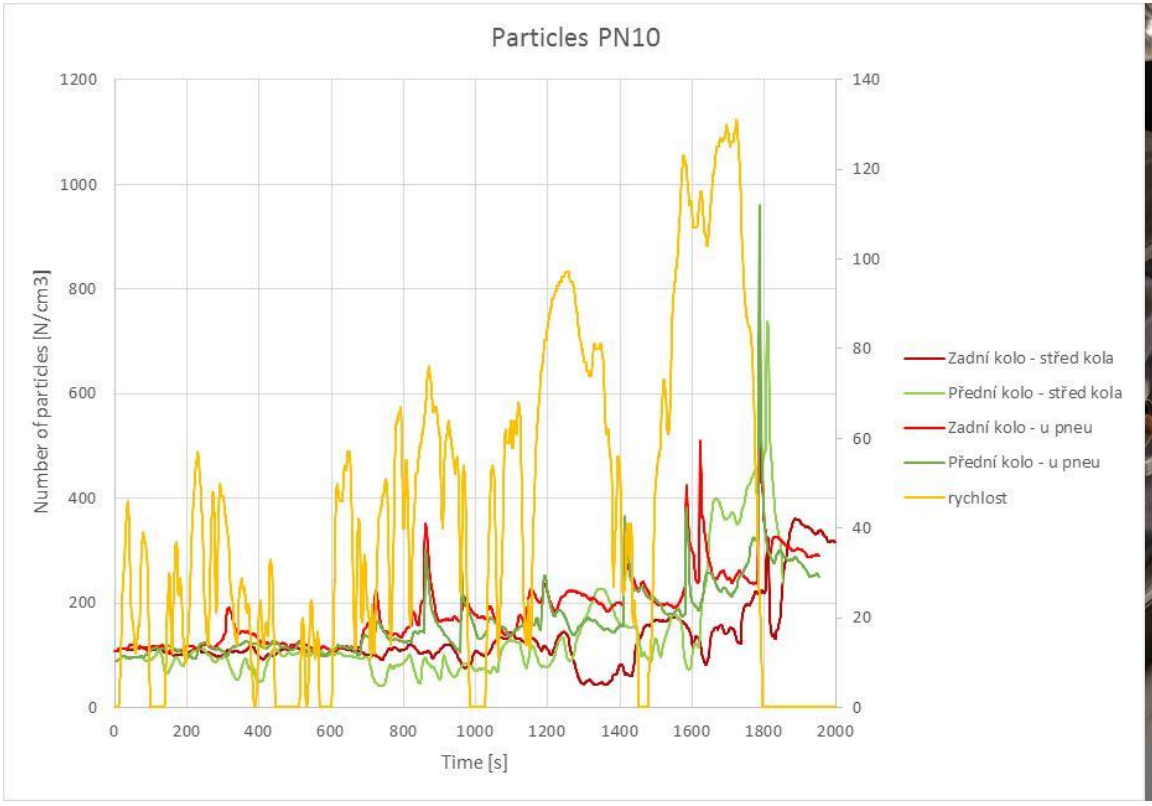
WLTP Brake cycle

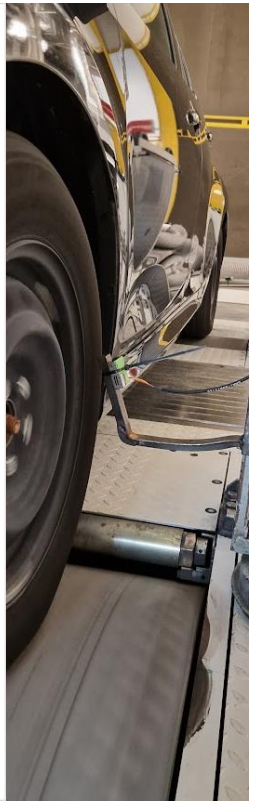
- Continuous control of the equivalent linear speed on the brake dynamometer
- World aproval brake cycle
- Duration 15 815 s
- 192 km of total distance
- 10 individual trips
- 303 brake deceleration events
- Pre-defined soaking times during the test

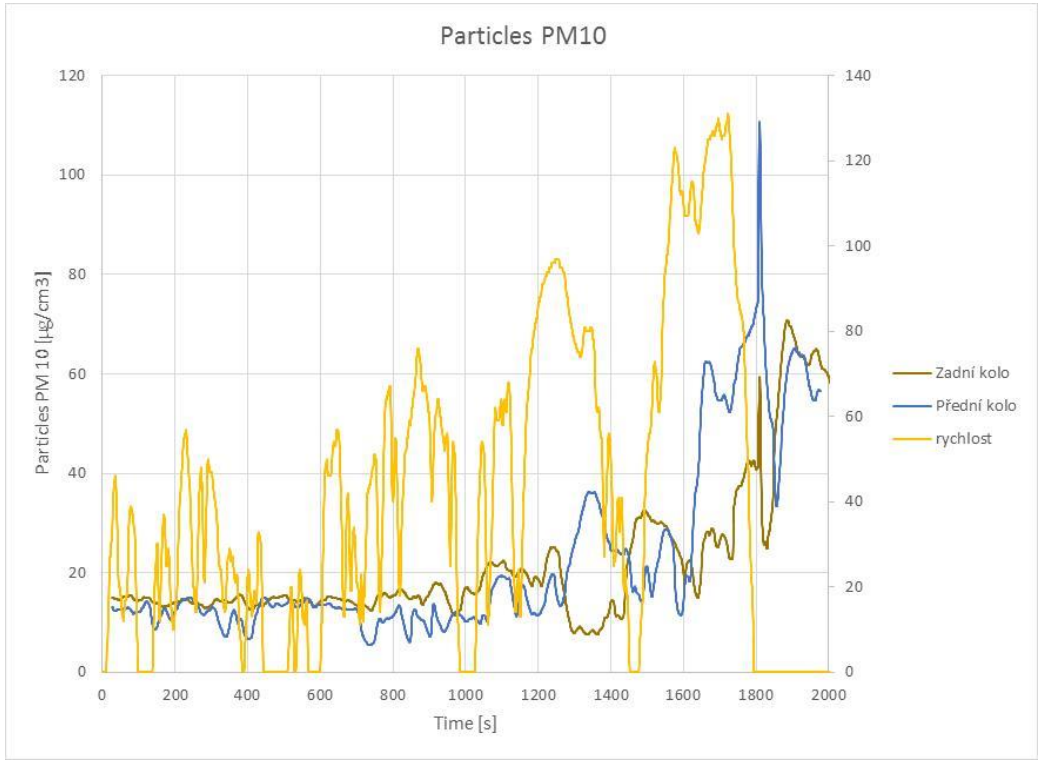


Activities in 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

Example of results:





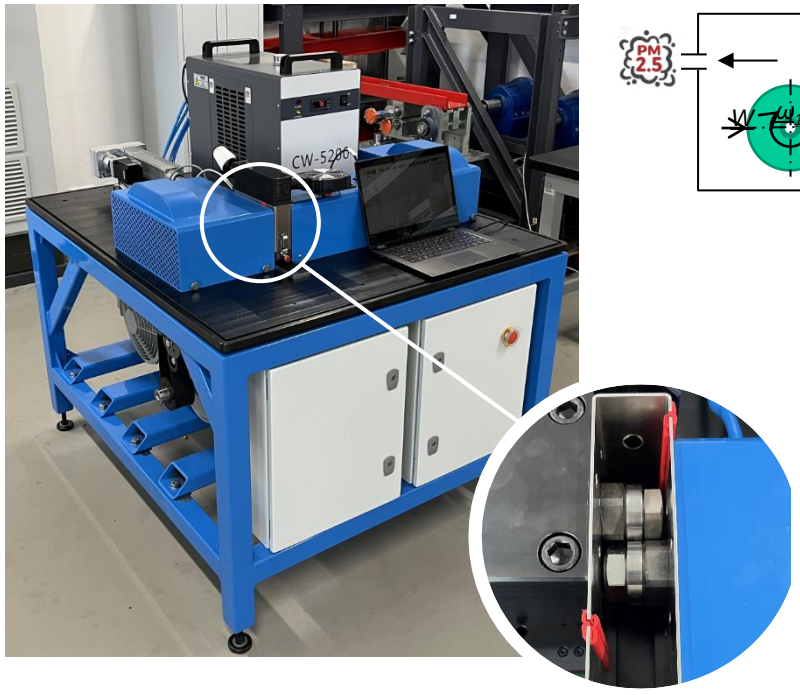


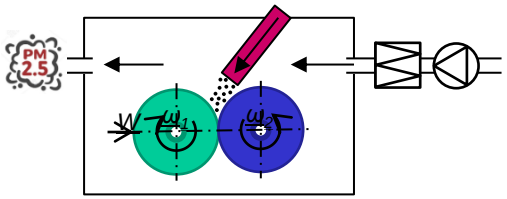
Activities in 3-WP08: Vehicle Emissions and Cabin Imissions

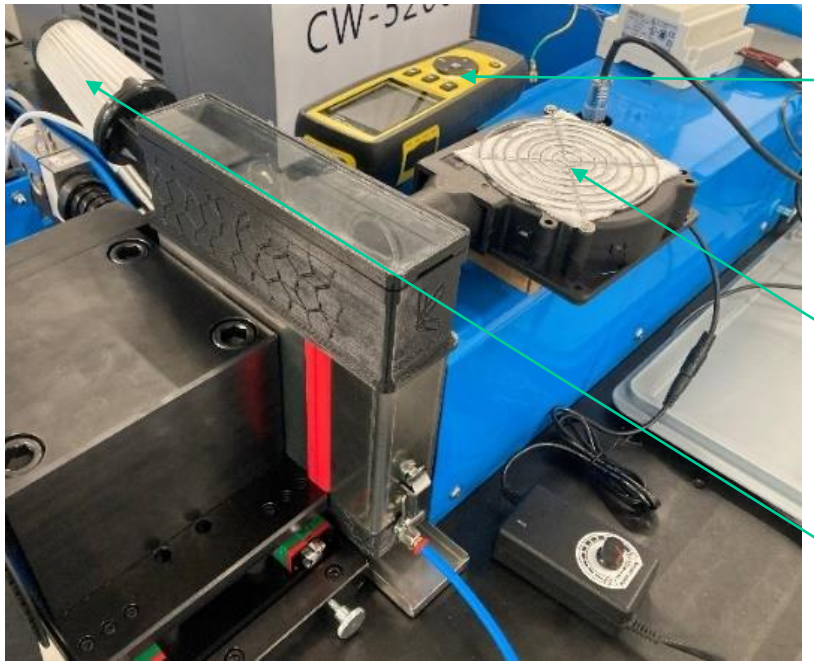
3-WP08-005: Research on the traction enhancers and technologies towards low non-exhaust emissions

I. Lab-scale twin-disc test rig (ČSN P CEN/TS 15427-2-2)

- implementation of wear particle monitoring to the testing methodology for Top-of-Rail products and traction enhancers







Particle counter TROTEC PC 220

Air flow controll GDSTIME

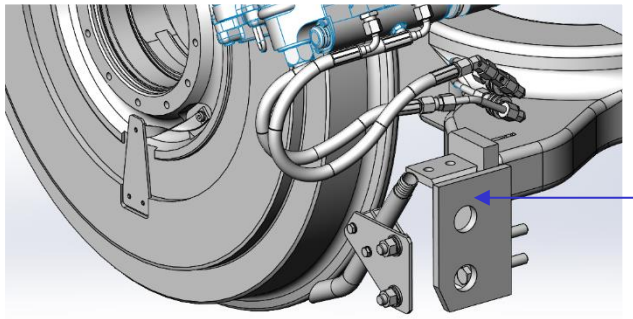
Particle sampling

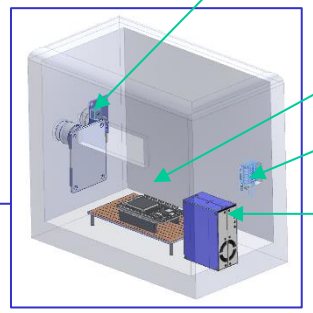
Activities in 3-WP08: Vehicle Emissions and Cabin Imissions

3-WP08-005: Device for an evaluation of particulate matter emissions from railway sanding

II. On-board device for a field tests:

- Monitoring of dust formation/resuspension related to sanding
- Experimental device for representative measurement/sampling
- Implementation of a sensor unit to the tram boogie

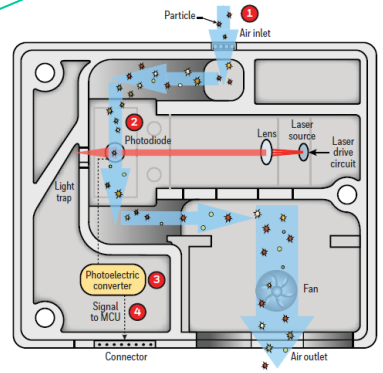




IoT board ESP32-LPKit

AirBoard-8266

Temperature + Humidity SCD41



Optical sensor PMS5003

Activities in 3-WP08: Vehicle Emissions and Cabin Imissions

3-WP08-006: Research on the traction enhancers and technologies towards low non-exhaust emissions

Particles sources in rail transport (non-exhaust)

- Wheel-rail contact wear
- Sanding to increase wheel-rail adhesion
- Friction management products

Problems in urban areas:

- Overuse of sanding
- Localised problem (stops, crossings, loops, uphill runs)
- Resuspension by road transport

Solutions:

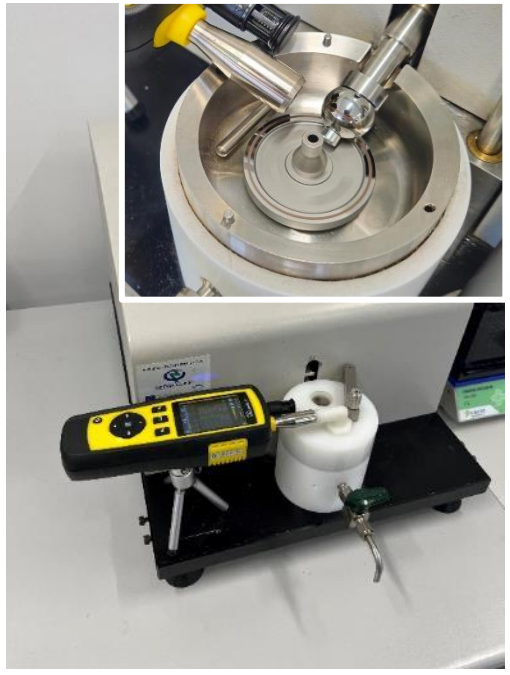
- New application units
- New application strategies
- New materials

Activities in 3-WP08: Vehicle Emissions and Cabin Imissions

3-WP08-006: Research on the traction enhancers and technologies towards low non-exhaust emissions

Research methodology:

Small-scale ball-on-disc



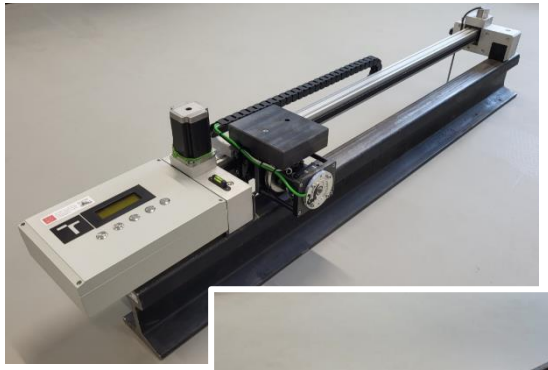
Small-scale twin-disc

3-WP08-005

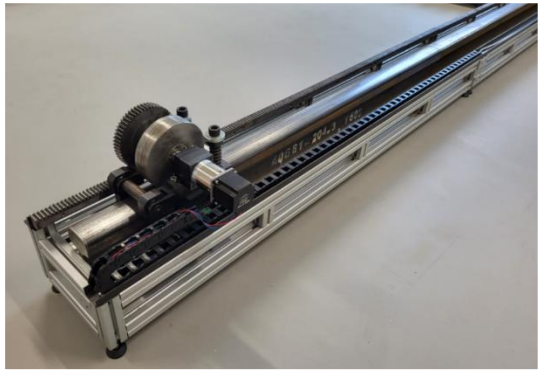
Full-scale twin-disc

UNIVERZITA PARDUBICE DOPRAVNÍ FAKULTA JANA PERNERA

Rail tribometer



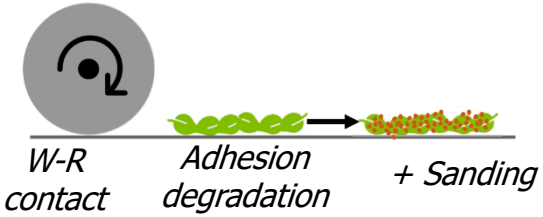
+ Contact simulator

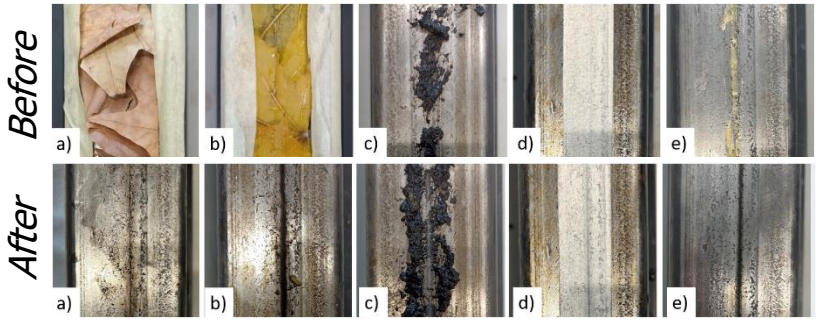


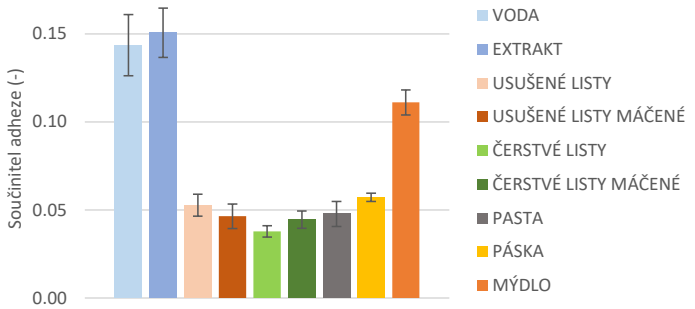
Activities in 3-WP08: Vehicle Emissions and Cabin Imissions

3-WP08-006: Research on the traction enhancers and technologies towards low non-exhaust emissions

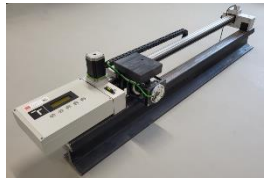
1. Adhesion degradation methods

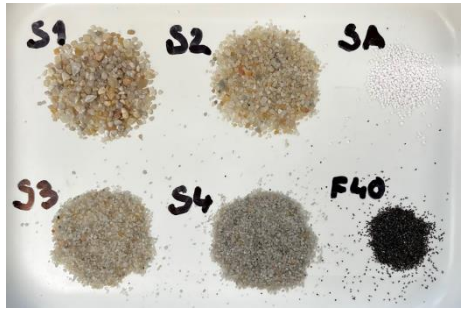


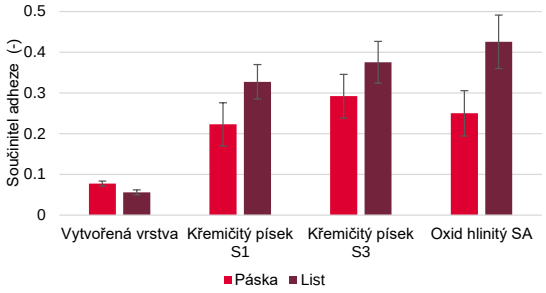


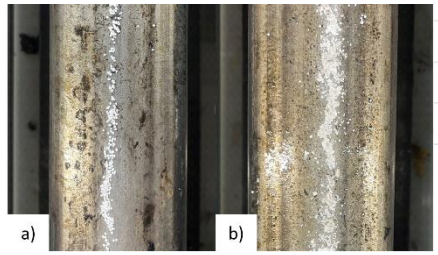


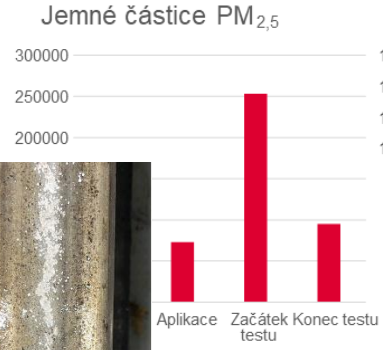
2. Efficiency of traction restoration + Particles emission

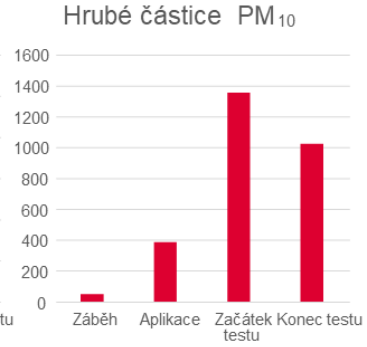












Fulfillment of goals and deliverables of 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

Current State of Deliverables, Milestones and Fulfillment of Goals

3-WP08-001: Definition of possible solution for future combustion engines aftertreatment control – design x prototype.

3-WP08-002: The design of testing rig was defined and prototype is under manufacturing

3-WP08-003: Evaluation and feasibility study of improved systems for aerosol control in car cabin were performed.

3-WP08-004: New methodology related to the non-exhaust emissions measurements and analysis from transport vehicles is creating.

3-WP08-005: The results respond to the long-standing unsatisfactory situation regarding dust from rail traffic in urban areas.

3-WP08-006: The results respond to the long-standing unsatisfactory situation regarding dust from rail traffic in urban areas.

List of Due Deliverables and Their Added Value

All activities within the 3-WP08 are in prescribed schedule. There are no delays. The deliverables will be prepared on planed time.

Fulfillment of goals and deliverables of 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

Current State of Deliverables and Fulfillment of Goals

- **3-WP08-001**: **Engine control strategy and aftertreatment setup toward EU7 limits fulfillment**, G-funk, V./2026, CVUT FME 0.6; SA 0.3; TÜV SÜD 0.1 – **in progress & no major delays:**
  - Monitoring & obtaining knowledge from EU7 proposal (still running).
  - Critical review about possible solution for future combustion engines.
  - Definition of possible solution
  - Prototype design.

- **3-WP08-002**: **Test bench for particle measurements**, G-funk, V./2026, CTU FME 0.4; TÜV SÜD 0.3; SA 0.3 – **in progress & no major delays:**
  - Test rig design definition – concept related to HW and SW solution.
  - Complete 3D model.
  - Manufacturing of the prototype.

Fulfillment of goals and deliverables of 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

Current State of Deliverables and Fulfillment of Goals

- **3-WP08-003**: Technologies for aerosol concentration mitigation in vehicle cabins - feasibility study, O – ostatní výsledky, XII./2025, BUT FME 0.7 , CTU FME 0.1, SA 0.2 – **in progress & no major delays:**
  - Obtaining data on particles (aerosols) entering the vehicle (MEB platform) from the surrounding environment (via the HVAC system).
  - Comparing concentrations in the surroundings of the vehicle and in the cabin of the vehicle when using the upgraded filters.
  - The data will be compared with the results from the previous project implemented for the MQB platform to compare the performance of cabin filtration.

- **3-WP08-004**: **Description of vehicle emission behavior in the lab. and under real driving conditions - methods and procedures for measurement in context of regenerative braking systems**, O – ostatní výsledky, XII./2024, CTU FME 0.5; BUT FME 0.2; TÜV SÜD 0.1; SA ost. 0.2 – **in progress & no major delays:**
  - Preparing collected knowledge for publishing the report.
  - Creating the database for further processes – continuously.

Fulfillment of goals and deliverables of 3-WP08: Vehicle Emissions and Cabin Imissions

Current State of Deliverables and Fulfillment of Goals

- **3-WP08-005**: Device for an evaluation of particulate matter emissions from railway sanding (ZV),G-funk, XII./2024, BUT 0.65; TRIBT 0.2; ŠTRN 0.1; UPa 0.05 – **in progress & no major delays:**
  - Design of a technical means for an experimental evaluation of airborne particle emissions of a wheel-rail contact was finished and implemented into a new small-scale twin-disc test rig (BUT + TRIBT).
  - Preparation for full-scale validation of the small-scale approach (BUT + UPa).
  - Assesment of the feasibility for the on-board PM monitoring (BUT + TRIBT + STRN).

- **3-WP08-006**: Research on the traction enhancers and technologies towards low non-exhaust emissions, O – ostatní výsledky, G-funk, VI./2026, BUT 0.65; TRIBT 0.2; ŠTRN 0.1; UPa 0.05 – **in progress & no major delays:**
  - Formulating an experimental methodology for research activities (BUT + UPa).
  - First lab-scale tests – degraded adhesion, solid lubricants, crushing proces, ... (BUT).
  - Draft concept for new approaches for traction enhancement (TRIBT + STRN).

Fulfillment of goals and deliverables of 3-WP08: Future Concepts in Pollutant/Emission Detection and Reduction

List of Due Deliverables and Their Added Value

- **3-WP08-001** - Novel engine and aftertreatment system setup can fulfill all main goals leading to lower emissions of vehicles while keeping the increase of the vehicle/power-train price as low as possible.
- **3-WP08-002** - Offering more efficient and easier to operate test device that would be used in the R&D process for simple testing to verify for example new designs of braking systems.
- **3-WP08-003** – Skoda auto expects to improve the filtration efficiency for nanoparticles and maintain the quality of ventilation in the cabin. Keep position and competitiveness on European and Asian markets.
- **3-WP08-004** - Saving time and money in area of R&D activities for vehicles manufactures. Next benefit will be shorter time for bringing the new braking technologies with lower level of dangerous pollutants.
- **3-WP08-005** - Allowing for the research of the materials for traction enhancement with respect to the particulate matter emissions from rail traffic and for the development of approaches to the emissions reduction
- **3-WP08-006** - Obtaining results and the experimental approaches forming the knowledge base for the development of materials and technologies for low-emission rail transport while focusing on non-exhaust emissions

Current contribution of 3-WP08 Future Concepts in Pollutant/Emission Detection and Reduction

Assessment of the Contribution of Deliverables

There is increase in international interest to characterize both exhaust and non-exhaust traffic-related gaseous and particle emissions. Until recently, exhaust dominated road transport emissions, and all regulatory efforts were aiming at their reduction. As exhaust emissions reduced, the relative contribution of non-exhaust emissions to overall ambient PM concentrations increased. Furthermore, there are concerns relative to possible adverse health effects of non-exhaust wear particles, and particularly of brake wear particles, due to their small size and their high metal content. The current methodology needs to simulate real-world driving conditions to the maximum extent possible and create harmonized measurement systems for scientific as well as for Research and Development (R&D) purposes.

Current contribution of 3-WP08 Future Concepts in Pollutant/Emission Detection and Reduction

Assessment of the Formal/Administrative Goals of the Work Package

All formal/administrative goals of the Work Package 3-WP08 are at the moment fulfilled.