Střelcová, K., Škvarenina, J. & Blaženec, M. (eds.): **"BIOCLIMATOLOGY AND NATURAL HAZARDS"**
International Scientific Conference, Poľana nad Detvou, Slovakia, September 17 - 20, 2007, *ISBN 978-80-228-17-60-8*

Production of limited pollutants from traffic in the Czech Republic

J. Jedlička, V. Adamec, J. Dufek, R. Ličbinský, J. Huzlík and M. Schwarzová

Transport Research Centre, Brno, Czech Republic (e-mail: vladimir.adamec@cdv.cz)

Abstract The most significant problem of traffic is air contamination with emissions especially due to their important effect on human health particularly in the large cities with high traffic intensity. Air is contaminated particularly with exhaust gases that contain in different concentrations hundreds of chemical compounds (emissions) with negative impact on environment and human health. Air polluting substances, to which the emission limits are applied, are carbon monoxide (CO), nitrogen oxides (NOx), non-methane volatile organic compounds (NM VOC) and particulate matters (PM) for diesel-fuel vehicles. While emissions per one car are decreasing, the volume of transportation is increasing. It is possible to say as results from long-time emissions audit in traffic, that emission of CO, NM VOC and NOx are decreasing by individual car transportation, because the new cars must fulfil the higher EURO limits. Road trucks are exception, production of these contaminants has progressive tendency by lorry transportation. The emissions of PM are probably the most significant contaminant for inter-annual increases. The paper presents emission development of these contaminants in period from 1993 till 2006 and prediction by the 2020 in Czech Republic.

Key words: *carbon monoxide, nitrogen oxides, non-methane volatile organic compounds and particulate matters, transport, emissions, emission factors, air pollution*

Introduction

One of the main objectives of our finalized project named "Stabilisation and Gradual Reduction of Environmental Burden caused by Transport in the Czech Republic" was to create credible emissions calculation methodology which suitable data are available for. Consequently, annual emissions of above mentioned pollutants per each year from 1990 to 2006 were calculated. The emissions values of actual year were got exact yearly, according to the actual data. The actual data are: current numbers and composition of Czech roll vehicle stock, annual consumption of petrol, diesel oil, LPG, CNG, biofuels and air fuels, chemical composition of fuels, transport performances, distances gone by passenger cars and trucks and measured emission factors in grams per 1 kg burned fuel. The further step was the transport emissions prediction to 2020 year, with regards to assumption of implementation of reduction measures. The predictions take into account the effectiveness of mentioned reduction measures and the differences between individual scenarios of transport development in the Czech Republic to 2020 year (Adamec et al. 2003).

Methods

The methodology takes into account the not only current logical approaches but also data availability in the Czech Republic. Also, the emission factors are reviewed with a help of special tests at the most used Czech and foreign cars. Cars are split to categories according to used fuel, transport mode and, at car transport, according to the use of catalytic converters. Freight vehicles using diesel oil are split to light duty vehicles (LDV) and heavy duty vehicles (HDV) (Dufek and Adamec, 2002a, 2002b).

Because of the lack of reliable data about the distances covered by cars, we had to use the total consumption of fuel sales, which are very well known in the Czech Republic. Traffic performances of individual car transport, road freight transport, public road transport, rail, water and air transport (passenger and freight) are used for the expression of fuel consumption distribution between transport modes.

The basic entry data are: measured emission factors, numbers of vehicles separated to a few categories, fuel consumption, fuel quality. Emissions from the combustion of each fuel are calculated separately.

Table 1. Emission factors of limited pollutants produced by the transport

Vehicle category	Emission factors			
	CO	NO_x	NM VOC	PM
	$g.kg^{-1}$ fuel			
Motorcycles	59,7	36,1	22,4	0
Conventional passenger gasoline vehicles	167,1	45,1	39,2	0
EURO-meeting passenger gasoline vehicles	22,6	2,8	1,9	0
Passenger diesel	5,4	10,1	1,1	1,8
Passenger LPG	35,2	5,2	26,4	0
Gasoline light duty vehicles	49,1	13,6	4,8	0
Diesel light duty vehicles	9,1	18,2	7,2	2,6
Diesel heavy duty vehicles	19,3	40,3	18,4	4,6

Results and discussion

The results of the limited emissions calculation are summarised in Tables No. 2 – 5.

Table 2. CO emissions by mode of transport [t]

Transport mode	*Year*										
	2000	2001	2002	2003	2004	2005	2006	2007	2010	2015	2020
Car transport	182 409	173 162	149 893	146 852	129 077	114 123	96 811	94 515	91 804	83 658	74 483
Public road	11 550	13 100	13 831	15 025	15 122	17 161	17 718	17 976	18 395	17 202	16 000
Road freight	81 707	89 994	87 070	91 054	88 421	98 671	95 981	94 648	91 038	83 458	75 801
Railway motor traction	2 052	1 914	1 855	1 815	1 795	1 697	1 657	1 608	1 559	1 513	1 467
Inland waterway	99	158	79	79	118	99	118	118	118	118	118
Air	565	722	825	953	1 116	1 021	1 023	1 049	1 059	1 069	1 079
Total	278 382	279 050	253 553	255 778	235 649	232 772	213 308	209 914	203 974	187 018	168 948

Table 3. NO_x emissions by mode of transport [t]

Transport mode	*Year*										
	2000	2001	2002	2003	2004	2005	2006	2007	2010	2015	2020
Car transport	41 543	38 884	31 431	30 835	27 360	24 490	19 757	19 149	19 073	17 544	15 615
Public road	9 943	11 532	11 979	13 354	14 094	16 507	16 971	17 240	17 720	16 848	15 964
Road freight	39 274	43 875	42 964	46 277	46 802	53 385	52 919	52 770	52 024	49 062	46 060
Railway motor traction	3 526	3 288	3 187	3 119	3 085	2 915	2 848	2 762	2 679	2 599	2 521
Inland waterway	170	271	136	136	203	170	203	203	203	203	203
Air	2 335	2 514	2 415	3 090	3 946	4 093	4 105	4 240	4 292	4 344	4 396
Total	96 791	100 364	92 112	96 811	95 490	101 560	96 803	96 364	95 991	90 600	84 759

Table 4. VOC emissions by mode of transport [t]

Transport mode	*Year*										
	2000	2001	2002	2003	2004	2005	2006	2007	2010	2015	2020
Car transport	36 607	34 149	28 241	27 446	23 867	20 538	16 392	15 985	15 775	14 413	12 855
Public road	2 020	2 261	2 525	2 750	2 724	3 075	3 217	3 288	3 399	3 258	3 111
Road freight	17 486	19 412	19 020	20 301	20 173	22 706	22 458	22 348	21 889	20 495	19 085
Railway motor traction	487	454	440	431	426	403	394	382	370	359	348
Inland waterway	23	37	19	19	28	23	28	28	28	28	28
Air	331	378	388	477	590	586	588	606	613	619	626
Total	56 954	56 691	50 633	51 424	47 808	47 331	43 077	42 637	42 074	39 173	36 054

Table 5. PM emissions by mode of transport [t]

Transport mode	*Year*										
	2000	2001	2002	2003	2004	2005	2006	2007	2010	2015	2020
Car transport	815	894	698	815	875	1 000	948	960	1 011	1 005	984
Public road	1 067	1 222	1 279	1 383	1 393	1 590	1 629	1 649	1 681	1 553	1 423
Road freight	2 771	3 057	3 020	3 223	3 177	3 543	3 527	3 516	3 453	3 244	3 033
Railway motor traction	272	254	246	241	238	225	220	213	207	201	195
Inland waterway	13	21	10	10	16	13	16	16	16	16	16
Air	0	0	0	0	0	0	0	0	0	0	0
Total	4 939	5 448	5 253	5 672	5 699	6 372	6 340	6 354	6 367	6 018	5 652

Emissions of carbon monoxide and volatile organic compounds show permanent decrease that is caused by gradual improvement of fuel quality. Production of nitrogen oxides does not change very much, but the essential decrease is predicted due to intensive change in Czech roll vehicle stock. The most serious problem is emissions of particulate matters (PM), showing permanent year-to-year increases. In the case of the PM, the balance of emissions from transportation includes only exhaust fumes emissions. It does not include emissions caused by abrasion of tires, by brake lining abrasion and also by so called secondary dustiness.

Conclusion

Reduction measures have positive impact of carbon monoxide, nitrogen oxides, and other organic compounds. It is proved, that the catalytic converters decrease the emission factors of CO, VOC and NO_x by 7 – 10 times. The main problems in the field of air polluting emissions from transport old diesel vehicles that emit excessive amount of CO and PM with the content of other health damaging matters: benzene, 1,3, buthadiene, polycyclic aromatic hydrocarbons, dioxines, etc.. Procedure of replacement of these vehicles is very slow, mainly due to high prices of these vehicles.

Acknowledgements

The study was supported by the Czech Ministry of Transport within these research projects: R&D No. 801/210/109 "Research of Environmental Burden from Transport" and Research Intention No. 4499457501 „Sustainable mobility – an opportunity for the future", part 5.2. „Negative transport impacts on the environment and possibilities of their reduction".

References

[1] Adamec, V., Dufek, J., Huzlík, J., Cholava, R., Jedlička, J., Klustová, P., Marešová, V. & Šucmanová, M. (2003): Research of Environmental Burden from Transport. Brno: CDV, 200 p. (In Czech).
[2] Dufek, J. & Adamec, V. (2002a): Database of Measured Emission Factors from Transport Sector. TRC, Brno, Czech Republic (In Czech).
[3] Dufek J. & Adamec, V. (2002b): Methodology of the Calculation of Air Polluting Emissions for All Transport Modes. TRC, Brno, Czech Republic, 24 p. (In Czech).
[4] Krobl L. (2001): Survey of Emission Factors of Road Motor Vehicles. ÚVMV, Prague, Czech Republic, 35 p. (In Czech).