VULNERABILTY ASSESSMENT - CZECH REPUBLIC

Based on local, regional, national and international studies, surveys and field campaigns

Version 1

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1. Abstract

In the Czech Republic is ensuring of adequate indoor air quality and their inspection among the tasks of the public health service as public health authorities. Most of the people spend approximately 90% of their time indoors. And primary schools are among the major type of microenvironment where 827 thousand students spend approximately 8 h daily; it represents approximately 6.5 thousand of individual school buildings. Investigation of indoor air quality in primary school buildings and in classrooms is needed to ensure children`s health and well-being.

As in other countries / project participants InAiRQ the state of primary school buildings in Czech Republic varies considerably. Several renovation works including the replacement of windows and/or the modernization of lighting, insulation and heating have been carried out in the past years. However, there are several factors (e.g., ambient air pollution, consumer/building products, etc.) which might have an effect on indoor air quality. The main problem of indoor air quality in primary schools in the Czech Republic are microclimatic conditions (temperature, humidity) and higher dust levels; in some cases, volatile organic compounds, including the excessive use perfumed cleaning products and exceptionally contamination by various substances as a result of technological indiscipline, even during routine maintenance.

The requirements for indoor air quality are quite well covered by legislation In the Czech Republic. Currently, limits of the indoor quality environment and the relevant legislation in the Czech Republic are updated. The problem is to keep a continuous control system and implementation measures, which are also dependent on the financial possibilities. We assume that just designed system, in which the school itself will control indoor air quality, will improve the situation.

Indoor air quality measurements have already been performed under lot of realised national campaigns and in the frame of international projects (SINPHONIE). As the basic problem can still be considered a lack of awareness among management and staff of schools and the need to increase their responsibility for the quality of the indoor school environment.

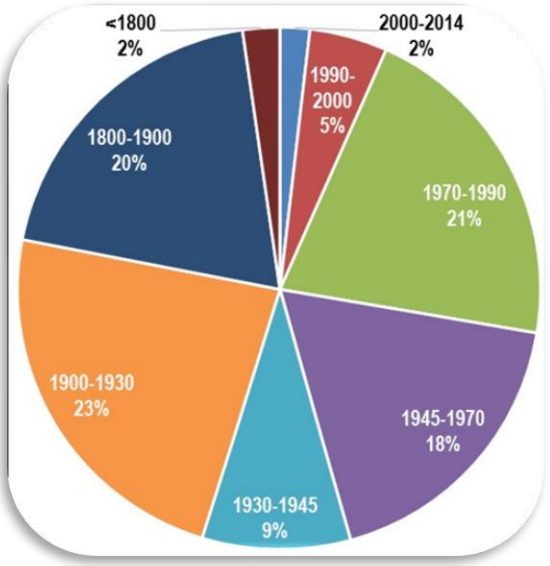
2. Primary school education and the state of school buildings in the Czech Republic

According to data for the school year 2013/2014 (later are not available even on the MINISTRY of EDUCATION) are/were in the Czech Republic 4 658 primary schools including 468 special schools and 489 schools of art. From this are 4 368 state primary schools, 243 private schools and 47 religious schools. And total of about 6.5 thousand school facilities, buildings, which were attended by, in the school year of 2013/2014, more than 827 thousand "children" in 42.3 thousand classrooms.

[Source: http://www.msmt.cz/vzdelavani/skolstvi-v-cr/statistika-skolstvi/vykonova-data-o-skolach-a-skolskych-zarizenich-2003-04-2014].

The state is responsible for providing public education, thus most of the schools (94%) are maintained by the state. Accordingly, the amount of financial support for reconstruction works can differ significantly among the schools.

A comprehensive overview about the types of school buildings is not available in the CR. In general, it is a complex of buildings from more than 100-year age to the newly-designed. And, of course, each period had different requirements and its own building characteristics; they differ in the building materials used, dimensions of the classrooms or energy consumption.



The percentage distribution of schools in the Czech Republic by age - results of the questionnaire survey of the state of school buildings, M. Begeni, V. Zmrhal, Czech Technical University in Prague, Faculty of Mechanical Engineering, Department of Environmental Engineering

[Source: http://vetrani.tzb-info.cz/vnitrni-prostredi/12873-dotaznikovy-pruzkum-stavu-skolskych-budov]

In the past decade, in relation to the possibility of using the EU operational programs and energy efficiency programs, some renovation works possible including the replacement of windows and/or the modernization of lighting, insulation and heating were made. Natural ventilation is used in the primary schools, installed forced air exchange systems are still few exceptions.

Outside the limited financial resources, the biggest problems during the reconstruction of school buildings, causing frequent occurrence of asbestos materials, and after reconstruction it is sealing new windows and increased demands on saving energy. Asbestos was a frequently used material for the construction of buildings mainly between 1950 and 1990. The risk associated with asbestos in the indoor environment is very widely understood by the public, a survey for the presence of asbestos in schools in the Czech Republic is carried out only in connection with the possible renovation of the building. At least at the present time, requirements for the use of low-emission materials are gradually beginning to be accepted. But - a new problem becomes significant - pressure from commercial entities seeking their own products to ensure air quality requirements and air exchange. These include the promotion of projects of forced ventilation, air cleaners, active coatings using photocatalytic activity of TiO_2 installed fragrant sources of aerosols ...).

Typical school (given the results of the questionnaire of frequency relative to the total number of responses received) restored in the form of insulation and replacement windows because of the energy savings. It is equipped with tight windows and ventilation is designed as a natural opening windows with manual operation at the discretion of the teacher. The windows are closed due to energy savings or safety of pupils during breaks (students are not supervised). For these reasons, there are problems with the quality of indoor air in large parts of the buildings. At some schools (26% of responses), complications arise with respect to its location near a busy road (noise) or pollution sources (local heating, industrial zones, etc.). Most schools have a relatively low number of floors, material used perimeter walls are brick and the roof is mostly sloping. [Source: http://vetrani.tzb-info.cz/vnitrni-prostredi/12873-dotaznikovy-pruzkum-stavu-skolskych-budov].

3. Policies on the indoor environment in school buildings

Current legislation covering elementary schools in the Czech Republic:

- Act no. 258/2000 Coll. The act on protection of the public health, § 13 Users buildings equipment for education and instruction, universities, school in nature, buildings for recreational events, buildings of health care facilities preventive care, social care institutions, accommodation facilities, buildings for trade and for gathering more people are required to ensure that the internal environment residential rooms in these buildings corresponded to hygienic limits of chemical, physical and biological indicators, adapted by implementing legislation
- Decree no. 6/2003 Coll., which define hygienic limits of chemical, physical and biological indicators for indoor environment of residential rooms
- Decree no. 20/2012 Coll., which amends Decree no. 268/2009 Coll., On technical requirements for buildings
- Decree no. 343/2009 Coll., which amends Decree no. 410/2005 Coll., On hygienic requirements on the premises and operation of facilities and establishments for the education of children and adolescents.
- Atomic Act no. 13/2002 Coll., as amended, and other regulations
- Decree no. 307/2002 Coll., on radiation protection

Table 2. Indoor air quality standards (hour average in μg/m^3) for some selected air pollutants in Czech (Decree no. 6/2003 Coll.)

Pollutant	limit	Pollutant	limit
$PM_{2.5}$	80	Styrene	40
PM_{10}	150	Ethylbenzene	200
Nitrogen dioxide	100	Formaldehyde	60
Ozone	100	Trichloroethylene	150
Carbon monoxide	5 000	Tetrachloroethylene	150
Asbestos and MM fibres	1 000	Bacteria (in air)	500 CFU/m^3
Ammonium	200	Mould (in air)	500 CFU/m^3
Benzene	7	Radon (*)	200 Beq/m^3
Toluene	300	Carbon dioxide (**)	1 500 ppm
ΣXylene	200		

Note:
(*) and 400 Beq/m^3 for reconstructed buildings (Atomic Act no. 13/2002 Coll.)
(**)Decree no. 20/2012 Coll., Value should never be exceeded

4. Review of indoor air quality data

The study of national importance under the system MZSO - Environmental Health Monitoring System in the Czech Republic (since 1994):

- 1994-1997, 60 flats of families with preschool children
- 1999-2001, 20 kindergarten and 120 flats of selected children
- 2003-2004, 100 flats in the most frequented area in the Czech Republic in five cities
- 2006, 20 primary schools in five cities
- 2008, 14 schools (10 classrooms in each of them) in 14 regions, total 140 classrooms
- 2015-2016, 25 nursery schools in five cities

Others:

- 2010-2012, Project SINPHONIE (5 elementary schools, weekly measurements always in three classes)

Indoor Air quality data are available in variably structured (pollutants, intervals..) worksheets, for their additional use in the project InAiRQ is necessary to define a uniform template. Realized measurements in schools, in the long term confirms, that the biggest problem of the indoor environment in Czech primary schools are aerosol particles fractions PM_{10} and $PM_{2.5}$ and approximately at 30 % of cases microclimatic parameters - i.e. insufficient air exchange and ensuring optimal range of temperature and relative humidity in the class rooms and gyms.

Exceptionally contaminations of areas are caused by technology lack of discipline during reconstruction occurs (unsuitable floor coverings and their installation and their emissions, using materials intended primarily for the outdoor environment - VOC, non-compliance with regulations in force in the reconstruction of buildings - asbestos, inadequate classroom equipment …..).

5. Outdoor air pollution in Czech

2015 - Environmental Health Monitoring System in the Czech Republic		Urban transport and industry unencumbered sites		Urban locations medium traffic loads		Traffic Hot-spots	Urban areas burdened industry		Rural background station CHMI	Rural, suburban stations						Estimation of the average values in the Czech cities
Pollutant	kategorie	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	2 - 5
PM10 µg/m3/year	ČR(bez MSK)	22,5	21,3	22,0	23,8	25,6	26,3	18,8	30,2	24,4	15,4	21,3	32,6	32,7	22,5	31,0	-	22,3
	M-S kraj	28,1	29,1	39,5	32,0	30,4	-	34,9	36,4	-	-	-	41,7	-	-	-	-	30,6
PM2,5 (µg/m3/year)		18,8	16,6	16,4	18,3	17,4	19,9	29,7	26,5	-	11,7	-	33,2	-	17,7	-	-	18,9
SO2 (µg/m3/year)		6,1	4,8	6,4	5,7	6,2	-	6,6	8,1	-	2,2	6,7	8,0	-	2,6	4,8	-	5,4
NO (µg/m3/year)		6,4	5,0	4,5	12,5	21,2	34,2	9,1	16,8	28,0	0,6	4,2	3,2	-	4,3	7,4	-	7,8
NO2 (µg/m3/year)		17,8	19,3	21,2	21,5	29,8	40,8	22,7	24,9	35,6	6,3	14,4	17,1	-	17,1	15,7	-	19,5
NOX (µg/m3/year)		27,0	23,5	23,6	40,2	63,0	93,9	35,5	53,9	78,6	7,0	20,7	22,1	-	23,4	27,1	-	29,5
CO (µg/m3/year)		202	367	325	366	426	604		376	565	256	-	-	-	-	-	-	342
O3 (µg/m3/year)		48,5	52,1	48,1	46,8	46,5	37,4	49,0	48,8		69,9	46,5	-	-	52,5	-	-	50,0
Benzen (µg/m3/year)		1,0	1,1	-	-	-	-	2,3	5,0	-	-	-	-	-	-	-	-	2,0
BaP (ng/m3/year)		1,18	1,12	2,03	-	1,12	-	3,83	3,63	-	0,36	0,58	-	-	-	3,89	-	1,27
As (ng/m3/year)		1,11	1,68	1,73	0,98	1,12	2,48	1,75	3,15	-	0,94	0,72	2,89	3,24	-	4,75	-	1,57
Cd (ng/m3/year)		0,18	0,22	0,20	0,17	0,20	0,16	2,10	0,49	-	0,12	0,14	0,79	0,21	-	0,28	-	0,20
Cr (ng/m3/year)		1,58	1,56	1,57	0,87	1,99	5,89	4,47	2,94	-	0,42	0,57	1,91	4,72	-	1,83	-	1,42
Mn (ng/m3/year)		6,14	8,34	9,54	2,50	9,15	13,93	36,93	34,24	-	2,98	4,67	8,07	10,58	-	7,50	-	7,68
Ni (ng/m3/year)		0,62	0,73	0,83	0,58	1,04	1,34	1,84	2,20	-	0,30	0,29	0,86	1,31	-	0,60	-	0,64
Pb (ng/m3/year)		6,1	8,4	7,5	4,6	7,3	8,1	30,3	21,9	-	3,9	4,5	6,0	8,0	-	8,6	-	8,2

For the evaluation of the environmental burden from the ambient air we can use the processing of air pollution data (currently at 2015) in defined types (categories) of urban areas. The assessment criterion included not only the intensity of surrounding traffic, but also the relative proportions of different types of heating systems and possible burden from significant industrial source. Air quality in the different types of locations is evaluated for health most relevant pollutants NO_2, PM_{10}, $PM_{2.5}$, As, Cd, Ni, Pb, benzene and BaP. In addition, the estimate of the burden of the common urban environment (i.e. the urban "background", without an extremely heavy transport and industry) is included. This

estimate is based on average annual concentration data obtained from urban monitoring stations in categories 2–5. The data of similar urban stations in the Moravian-Silesian region were not included to this estimate due to the higher area burden compared with stations in other regions of the country, and they are evaluated separately.

For better understanding:

Categorization of measurement sites/zones according to NIPH

(Based on, and modifying 97/101/ES: Council Ruling of 27. 1. 1997, regarding the introduction of mutual exchange of information from networks and individual measuring stations monitoring outdoor air in member states, Official Journal L 035, 05/021997 P. 0014 – 0022)

Basic categories:

URBAN

1. Urban background (area without significant evaluable sources, without traffic – parks, sports grounds, bodies of water, unused land etc.).

URBAN RESIDENTIAL (housing estates, satellite towns, suburbs, shopping malls, hospital grounds, housing developments incl. small-scale service and manufacturing premises).

2. Urban residential zone with local sources only (suburbs, satellites, allotments, low-level traffic equivalent to 2 000 vehicles/24 hrs. and/or at a distance in excess of 150 m from a major highway or crossroads and/or on the shielded side of a building away from such a highway or crossroads) REZZO 2 local sources for heating in commercial, administrative and residential buildings – URBAN RESIDENTIAL LOCAL HEATING.
3. Urban residential zone without local sources of emission (housing estates heated by remote central sources, low-level traffic equivalent to 2 000 vehicles/24 hrs. and/or at a distance in excess of 150 m from a major highway or crossroads and/or on the shielded side of a building away from such a highway or crossroads) – public energy, remote heating URBAN RESIDENTIAL.
4. Urban residential zone with local and remote central sources of heating, traffic equivalent to 2 000 – 5 000 vehicles/24 hrs (urban category road network) and/or at a distance in excess of 150 m from a major highway or crossroads and/or on the shielded side of a building away from such a highway or crossroads) – URBAN RESIDENTIAL LOW TRAFFIC.
5. Urban residential zone with local and remote central sources of heating, traffic equivalent to 5 000 – 10 000 vehicles/24 hrs (urban category road network, major roads) and/or at a distance in excess of 150 m from a major highway or crossroads and/or on the shielded side of a building away from such a highway or crossroads) – URBAN RESIDENTIAL MEDIUM TRAFFIC.
6. Urban residential zone with local and remote central sources of heating, traffic in excess of 10 000 vehicles/24 hrs - open roads (buildings at a distance of at least 10 m from the road) – URBAN RESIDENTIAL TRAFFIC.

7. Urban residential zone with traffic in excess of 10 000 vehicles/24 hrs (enclosed roads, canyon shape) and transit roads with traffic in excess of 25 000 vehicles/24 hrs – URBAN RESIDENTIAL HEAVY TRAFFIC.

URBAN INDUSTRIAL

8. Urban industrial zone with greater load from technology than traffic (up to 10000 vehicles/24 hrs) on air quality.
9. Urban industrial zone with greater load from traffic than technology: includes railway junctions (stations, depots etc.).
10. Urban industrial zone with significantly greater load from traffic (in excess of 25 000 vehicles/24 hrs) than technology.

RURAL

11. Background – woodland, parks (non-urban), pastures, non-cultivated land, bodies of water, fields etc.)
12. Agricultural – effects of agricultural sources – cultivated land
13. Industrial – predominant effects of industry over traffic
14. Industrial with traffic load – predominant effects of traffic over industry
15. Residential zone with low level traffic (up to 2 000 vehicle/24 hrs)
16. Residential zone with middle traffic (2 000 – 10 000 vehicles/24 hrs)
17. Residential zone with heavy traffic (>10 000 vehicles/24 hrs)
18. Traffic load (>10 000 vehicles/24 hrs) without housing development (zones 1 and 2)

Notes:

1. For industrial zones the type of industry is not primarily evaluated. However, in terms of pollution the type of industry plays a more important role than volume of traffic – metallurgy, assembly shops, paint shops, breweries (without own heating sources), chimney height etc. Industrial sources were accordingly categorized as above.
2. For categories defined by use (industrial, urban or otherwise) the major sources of pollution are emphasized (e.g. one of three – traffic, industry, heating).
3. Rural zones are defined by a population of up to 2000 inhabitants in rural areas
4. Categorization necessitates taking into account the long-term load in a given locality.

All selected schools that will participate in the project InAiRQ are located in areas of urban categories from 2nd to 5th.

Air quality data from year 2016 will be available in the form of outputs from measuring stations during June-July 2017. It applies also to data from the national air pollution network are regularly transmitted by the Czech Hydro meteorological to the AIRBASE network (http: //www.eea.europa.eu/data-and-maps/data/airbase-the-european-air-quality-database-7/en). NIPH runs the Oracle database, where the data are being processed and every year worked out annual report, which includes both basic evaluation and interpretation of measured values and evaluation of health risks from outdoor air. This assessment of health risks from outdoor air is also included in the report for the Czech Government.