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REGULAR ARTICLE

AIR AS A FACTOR AFFECTING FOOD HYGIENE

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ABSTRACT

The air is the most endangered component of the environment. The air pollution has not only got various economical and ecological consequences but also has various negative effects on human health, animals, plants and food hygiene. Elevated anthropogenic SO_2 emissions can also have negative influences upon the environmental conditions, human health, and ecosystems. The most emissions come from industrial chimneys, heavy traffic emissions and population density. It is inevitable to monitor the state of the air pollution. Submitted work includes the summary of the sulphur dioxide pollution and its impact on the environment in the area of chemical factory Duslo Šaľa, Inc. Monitoring anthropic impacts help us to predict what requirements on space particular industry requires and how they act in the area. The basis of our evaluation was observing diversity monitoring and types of negative anthropogenic features in monitored area: concentrations of SO_2 in air, real sources of air pollution from the vehicles and other mechanisms and real sources of air pollution from local town residential area sources.

Keywords: Air pollutant, Emission inventories, Food hygiene, Sulphur dioxide

INTRODUCTION

The Slovak Republic has been monitoring and evaluating emissions for years. It is important mainly in the areas which are damaged by anthropic influence, where energetics, traffic, industry and agriculture have been dominant and pollutants escape into the air (**Hreško *at el*., 2008**). The global emission sources of air pollutants caused by the human activity differ in the type of pollutant. It is obvious that the worse air quality is caused by gases as sulphur dioxide (**Li *at el*., 1999; Ayres, 1997**), nitrogen oxides (**Brunekreef, Holgate, 2002; Lightowlers, Cape, 1988**). The anthropogenic sources of emissions include industrial processes, agriculture, traffic, mining, energetics and others (**Brunekreef, Holgate, 2002; Ercelebi, Toros, 2009; Khlaifi *et al.*, 2008; Prousek, 2001**). High consumption of the energy in industry as well as high consumption of energy per inhabitant, which exceeds the average numbers of other developed EC countries, is remarkable in high production of sulphur oxides and nitrogen oxides **(Demo, Bielek, Hronec, 1999)**. Particular substances have emission limits and long - term protection plans not only for human health protection but also for the ecosystem and vegetation protection. According to this fact, evaluation of pollution contents and monitoring of their diffusion into the country is very important (**Ying, Ma, Xing, 2007; Bhumralkar, 1981)**.

Harmfulness of the pollutants is considered from the hygienic and global point of view, mainly concerning influence upon climatic conditions and life on the Earth (**Dubcová**, ***et al.*, 2008; Tóth, *et al.*, 2010; Vollmannová, *et al.*, 2008**). Sulphur oxides (SO_x) form complex compound of polluting substances. The most important are sulphur dioxide (SO_2) and sulphur trioxide (SO_3). Sulphur dioxide (SO_2) is formed by the burning of sulphur containing fossil fuels, by melting mineral raw materials and other processes. Sulphur dioxide rank among the principal pollutants contaminating the urban atmosphere. Another source of SO_2 pollution is heating the houses. However, the amounts of emissions have decreased within recent years as a consequence of changing the fuel type and its quantity and using of separatory technologies, as it is mentioned in the documents of the Regional Environmental Office in Nitra *Information about air quality and particular sources sharing on its pollution* (**2006**). Furthermore, the character of emission sources have changed when small sources has been replaced by big particular sources which diffuse pollutants high above so that the concentration of sulphur dioxide has been lowered in big towns which had been polluted before. Presence of sulphur dioxide goes together with increased concentration of nitrogen oxides.

MATERIAL AND METHODS

Submitted work includes the summary of the sulphur dioxide pollution and its impact on the environment in the area of Duslo Šaľa, Inc. – the biggest chemical factory in Nitra region. The basis of the work consists of the sources (industrial, transport, urban development) that take part in the increase of pollutants and at the same time reflects chemical industry development in the region. The aim of the work is, on the basis of real load of the countryside with SO_2 pollution, in delimitation of the countryside to present the importance and exploitation of the Czekanowsky method of inside homogeneous entities. The monitoring of pollutant indicators and their transport supplies information and dates to consider the emission conditions. According to the threat territory pollution with SO_2 on the basis of our analyses, we can predict what requirements on space particular industry requires and how they act in the area (integration of imissions in selected period with the intensity of transport element group and the intensity of urban development element group). The predicted and our research supported emission concentrations occur in urbanized areas where they impact the urban environment as well as working environment.

Monitoring anthropic impacts we monitored in following steps:

- concentrations of SO_2 in air – on monitoring places affected by emissions released from chemical factory Duslo Šaľa, Inc.,
- the matrix of area cartographic procession and formation,
- diffusion study process,
- comparison of measured and counted concentrations in model situations,
- the method of differences and similitude,
- the analysis of air pollution in monitoring of anthropic impacts in landscape ecological evaluation of the area.

The SO concentration in the air

The SO_2 concentration from chemical factory Duslo Šaľa, Inc. was monitored in two phases:

- 1st phase – the analysis of chosen air samples in laboratory conditions in years 1999-2003. In the first phase the samples taking was realized in three testing points (Duslo

Šaľa, Inc., Trnovec nad Váhom, Šaľa – Veča). Sulphur dioxide was defined with colorimetric method according to STN 03 8211 (**1987**).

- 2nd phase – since 2003 the imission concentration has been measuring with chemiluminescence method obtained from stationary background measuring point for suburb of Trnovec nad Váhom.

The usage of the analyses of air samples results (SO_2) in landscape ecology evaluation of tested area

The area is situated in four maps in the scale 1: 10 000 (maps sheet numbers: 1145-12-24, 1145-12-25, 1145-14-04, 1145-14-05) and includes 7140 ha. They were transformed to make coherent whole. All area of interest was divided into squares 200 x 200 m forming raster with 1776 squares (37 x 48 = 1776). The matrix serves for the whole area characterization according to chosen categories. From the cartographic base there have been printed four types of thematic maps (Map 1. The Occurrence of Element Group of Transport, Map 2. The Occurrence of Residential Elements, Map 3. Anthropic Impacts on the Elements of Secondary Landscape Structure, Map 4. The Threat of Secondary Landscape Structure by Imissions). The basis in map legend making is optical scale of Czekanowsky method. Internally homogeneous elements details (The method of difference and similitude) perform summary of values. The ranges expressed the intensity of features monitored in chosen categories. We made ranges dependent on the indicators choice. Isolines of maximal short term concentration of SO_2 were transformed into digitalized map. The isolines were used for areal elements including the area between particular isolines that were later used for other evaluation of environment threat. New evaluation matrix was made to analyse the cooperation of relations between the transport elements and residential elements. The secondary landscape structure with landscape elements (transport, water wood vegetation elements, grass vegetation, agricultural cultures, residential and technical elements) isolines of maximal short term concentration SO_2 and evaluating matrix was the basis for evaluation of tested area.

RESULTS AND DISCUSSION

The diffusion study has been figured out on the basis of selected emissions development in the monitored period from the chemical factory Duslo, Inc. Šaľa. (Fig. 1) The amount of emissions from chemical factory Duslo Šaľa, Inc. has depended on the amount and quality of used fuels and production needs. The largest amount of emission was in 2001 (SO_2=1506.10^3 kg). The year 2007 was the year with the lowest value of emissions from Duslo Šaľa, Inc. (SO_2 = 6.10^3 kg).

The concentrations of pollutants were counted with the help of Gaussian air pollution model (**Hesek, Mitošinková, 1991; Hesek, 1994**). The counted result of pollutants concentration were compared with measured results. Comparing short term counted and measured SO_2 concentrations in 1999 – 2003 we may add that none of the monitored point (Trnovec nad Váhom, Duslo Šaľa, Inc., Šaľa – Veča) had exceeded value of imission limit of SO_2 ($IH_{k(SO2)}$ = 500 μg.m^{-3}). The results are influenced by meteorological situation (the wind direction and wind power, temperature and rainfall). Long-time pollutants concentration was counted with stability category that is in the summer influenced by good emission diffusion and in the winter with low diffusion intensity (**Hesek, 1995**).

In the areas with a flat terrain the agreement between counted and measured values of pollutant is good **(Hesek, 1991)**. During monitored years (1999 - 2003) the pollutant did not exceed the limits of average concentration ($IHr_{(SO2)}$ = 60 μg.m^{-3}) (The Enclosure 1 to The Decree of MoE SR No. 706/2002 Coll.) The average values of measured maximum annual concentrations are below the border of imission limits.

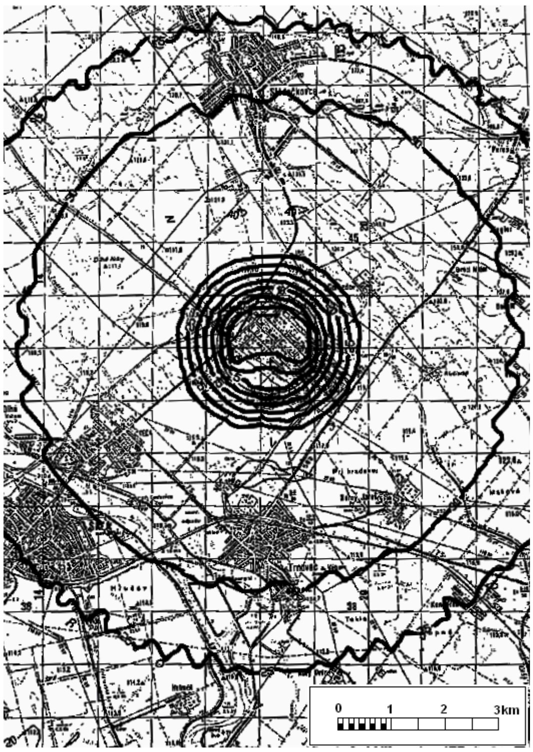

Figure 1 Distribution of the maximum short - term SO_2 concentrations in 2000 [μg.m^{-3}]

Imissions

The differences between the monitored concentrations of sulphur dioxide in the monitored period were noted in particular years as well as between measuring points (Tab 1).

Table 1 The average annual concentrations of air pollutant

			SO_2 [μg.m^{-3}]		
Measuring points	1999	2000	2001	2002	2003
Trnovec nad Váhom	1.13	6.17	12.62	7.83	12.70
Duslo Šaľa, Inc.	1.52	5.27	5.60	3.33	-
Measuring point	2004	2005	2006*	2007*	2008*
Trnovec nad Váhom	6.50	10.02	6.54	7.18	5.91

Source: *Duslo Šaľa, Inc. 2009

The analysis of the air quality in monitoring of anthropic elements in landscape ecology evaluation of the area

The basis of our evaluation consist of diversity monitoring and types of negative anthrophogenic features in monitored area. This part is synthetic and compares the expected imissions and real imissions as well in connection with secondary landscape structure.

The synthesis expect following steps:

1. The choice of the sources influencing imissions rate as well as reflecting the chemistry development in the tested area. We considered various factors to choose: availability of material, process form and the aim. The chosen indicators were obtained by monitoring air pollution analysis in the factory Duslo Šaľa, Inc. statistic process and processing of existing materials. The result of this part is the set of cartographic materials showing the development indicators connected with particular branches in the area. This cartographic material shows indicators connected with existing branches causing increasing concentrations pollutants in the country.

2. The secondary landscape setup is the function of two definitive integrating processes – natural and anthropic (**Jančura, 1999**). Map 1. and Map 2. deal with first sectional synthesis of transport and residential elements. It results in Map 3. with marked isoline of maximal short – term concentration SO_2. The most loaded area is that of Duslo Šaľa, Inc. And the least are suburb areas as the town Šaľa, Riegler, Kenderes.

3. The land ecology synthesis – threatening of secondary landscape structure with chosen contaminants. The secondary landscape structure reflects not only changes made by the men in the primary landscape structure but also socioeconomic aspect, the usage of the soil in tested area (**Miklós, Izakovičová, 1997; Holúbek, 2007**). According to the tested area there were selected four landscape elements as units of secondary landscape structure: water (water surface, water courses, canals), the elements of wood vegetation (broad leaved forests, linear vegetation), persistent grass vegetation (pasture lands, meadows), agricultural cultures (fields, vineyards, fruit groves, gardens), residential elements (buildings, parks, courtyards), technical elements (industrial areas, agricultural objects), transport (main roads, minor roads, bridges and footbridges, functional metalled roads, unmetalled roads, important paths). In the ecological point of view we differ stability elements (ecological and biotic important places – biocentres, biocorridors and conservation areas.

Relation of imissions and secondary landscape structure

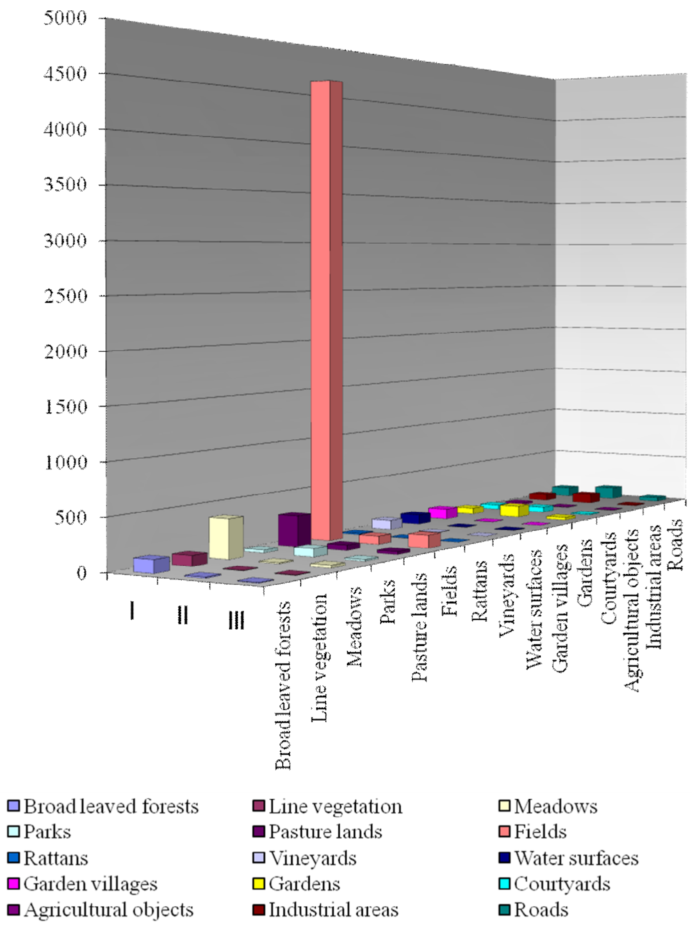

Figure 2 Percentage evaluation of endangered landscape features

Intersection of imission models and the secondary landscape structure enables the interpretation of endangered and endangering features. We will consider the features resulting from imission to be the endangering features and biotic elements to be endangered features (**Wellburn *et al*., 1981**). There are several categories of endangering features. Water surfaces, water courses, canals, broad leaved forests, linear vegetation, pasture lands, meadows fields, vineyards, fruit groves, gardens, courtyards, main roads, minor roads, bridges and footbridges, functional metalled roads, unmetalled roads, important paths, biocentres, biocorridors, protected territories are considered to be endangered landscape elements. The landscape elements mentioned are divided into three categories: natural sources, the part of ecological stability system, environment. Fields occupy the largest area. (Fig. 2)

CONCLUSION

It is difficult to evaluate the qualitative changes on the secondary landscape structure caused by anthropogenic effects exactly. The basis of our evaluation was observing the diversity of anthropic effects; the more types of negative anthropogenic effects occur on a particular place, the bigger is their effect on the place. The syntheses presumed following steps: evaluation of imissions in the area, interpretation of secondary landscape structure,

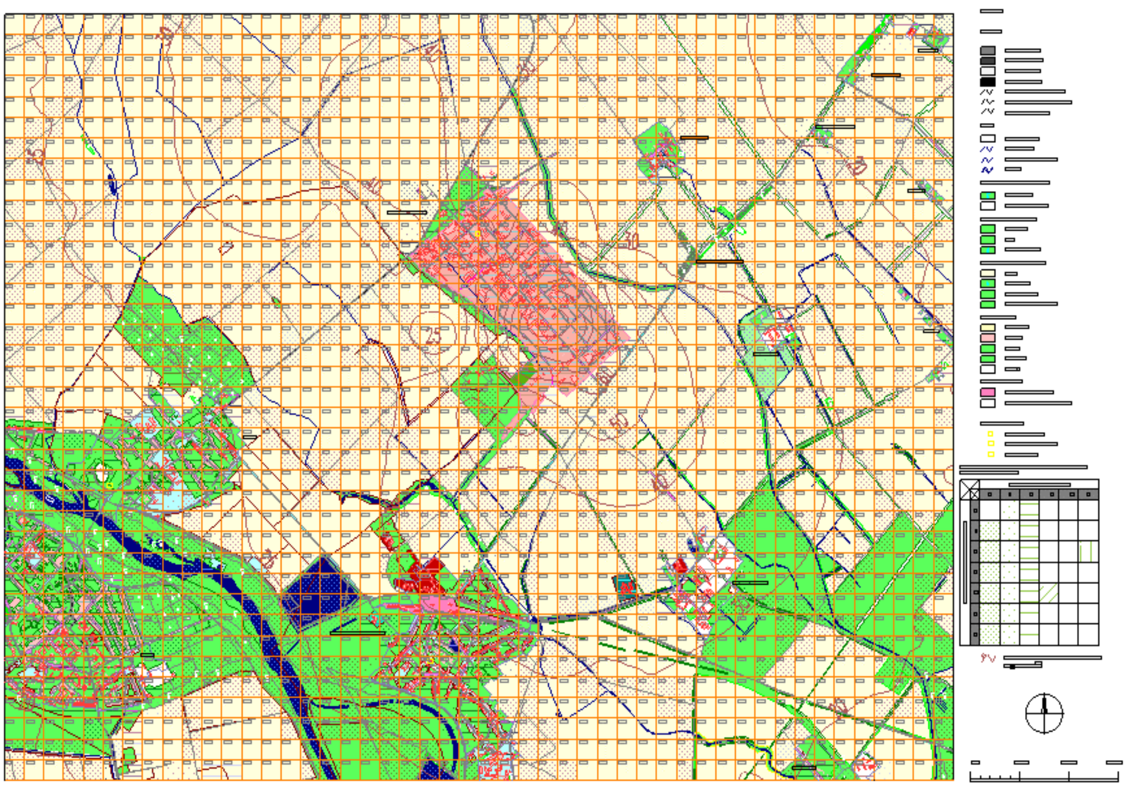

Figure 3 Anthropic Impacts on the Elements of Secondary Landscape Structure

threat of secondary landscape structure with chosen contaminants. Selected indicators have been reached by monitoring and analysis of the air quality in the area of Duslo Šaľa, Inc. together with statistic dates and existing documents. We have compared imissions SO_2, presumed and real with secondary landscape structure. We have expressed it in the system of endangered and endangering effects. Used parametric analysis has analyzed interactivity among relations and was transformed into four maps. The space relation expressing interactive impacts of transport and residential elements, real and expected imissions show space collisions of secondary landscape danger. (Fig. 3) The concussing synthesis aims at possible danger of landscape features which enables to predict the danger. The analyses and evaluation of various anthropic impacts in the land are help to form the classification of environment. The results taken from the interpretation of secondary landscape structure and space relation can be used in ecological systems of urban development stability planning, in environmental predictions and in environmental health solving. This belongs to current problems deserving strong attention of all parties included. The food hygiene is the first step which starts the whole process of healthy style of living. Air quality affects the soil hygiene and subsequently the plant production.

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