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MONITORING THE EFFECT OF THE MUNICIPAL WASTE DUMP IN KRYNICA ON ENVIRONMENT

The pollution of atmospheric air in the immediate vicinity of a municipal waste dump in Krynica spa was examined. The latest results of examination being carried out in 2000 were compared with earlier results obtained before the dump was built and at the beginning of its operation.

1. INTRODUCTION

Recycling of scrap materials is a problem that has been existed from the dawn of human history. Modern societies also consider it as a severe problem. In the regions with a dense population of people, the amount of municipal refuse, whose quantity is connected with progress of civilization, actually grows up to 250–700 kg per capita per year.

In literature, there is no useful information on comprehensive opinion about the waste dump impact on environment. Based on long-lasting research [1], [2] dealing with basic indexes characteristic of individual components of environment, the present results of investigating municipal waste dump in Krynica, one of Polish health resorts, are presented.

2. THE INFLUENCE OF THE DUMP ON ENVIRONMENT

The dump of municipal scrap materials and sediments from sewage treatment plant for the community and the Krynica spa (figure 1) started its operation in January of 1996. In the first period of storing, which lasted one year, the capacity of the dump was 55,000 m^3, while in the second period (2002–2008) it should approach 73,000 m^3. By the end of 2000 about 52,000 m^3 of scrap materials and sediments were accumulated. The municipal waste dump because of its characteristic structural features (large and open structures exposed to atmospheric impact) influences all of environ-

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mental components. In real life, the range of this impact and its extent can be different; however, ground and underground water, air and soil are most exposed to contaminations. Current legislation connected with water classification and admissible values of the concentrations of air pollutants allow us to reduce the degree of pollution, and in the case of bacterial pollution – Polish Norms should be fulfilled. Conditions of arable land were estimated based on the guide-lines laid down by the Institute of Soil-Cultivation, Fertilizing and Pedology [8].

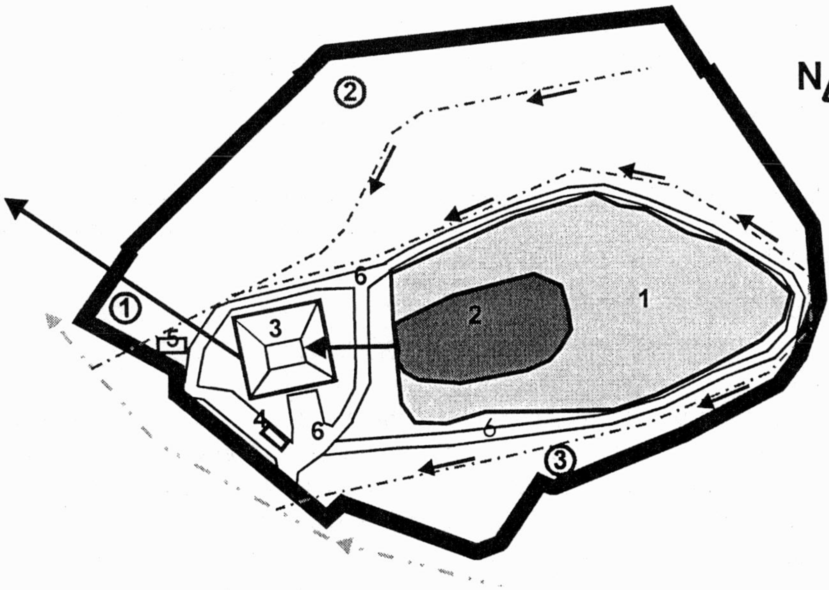

Fig. 1. Air sampling points on a municipal waste dump in Krynica spa
1 – reservoir of a dump, 2 – scrap materials, 3 – outflow tank, 4 – disinfecting pool, 5 – office building, 6 – access roads, 7 – outer ditches, 8 – surface stream, 9 – sewerage, ①–③ – control points, the arrows indicate direction of water flow
<1000 bacteria/m^3 – unpolluted air [6]

Results of water, air and soil tests were presented in [1]–[3]. We should pay more attention to emission of bacterial pollutants which are very dangerous both to people and environment [4], [5]. As can be suspected (see figures 2–4 and the table) the quality of atmospheric air in the vicinity of the dump regularly deteriorates. This phenomenon is connected with exploitation of municipal scrap materials; however, the range of problem can be limited by suitable technical measures (for example, mechanical partition made in different ways), which counteract the migration of polluted materials to environment. Configuration of the land and direction of the air masses in a direct neighbourhood of the dump are responsible for heavy pollution which has been recorded in the measuring point no. 1.

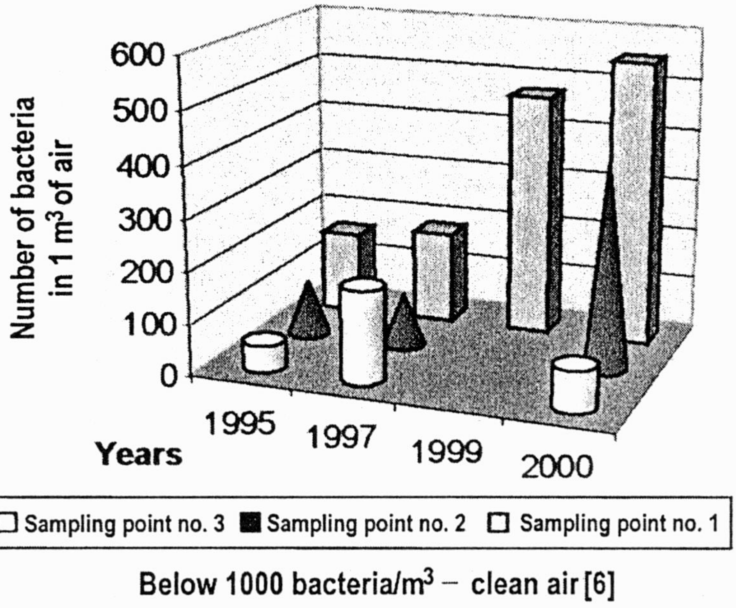

Fig. 2. A total number of bacteria in one cubic meter of air

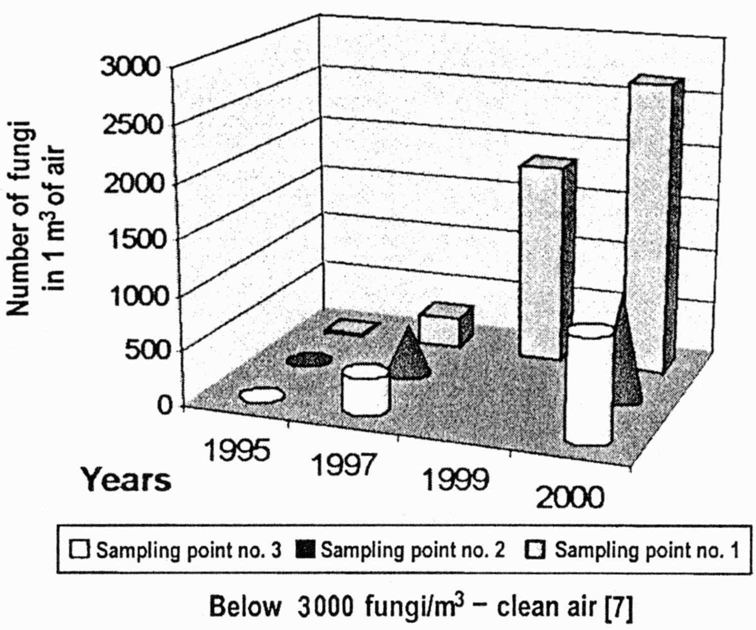

Fig. 3. A total number of fungi in one cubic meter of air

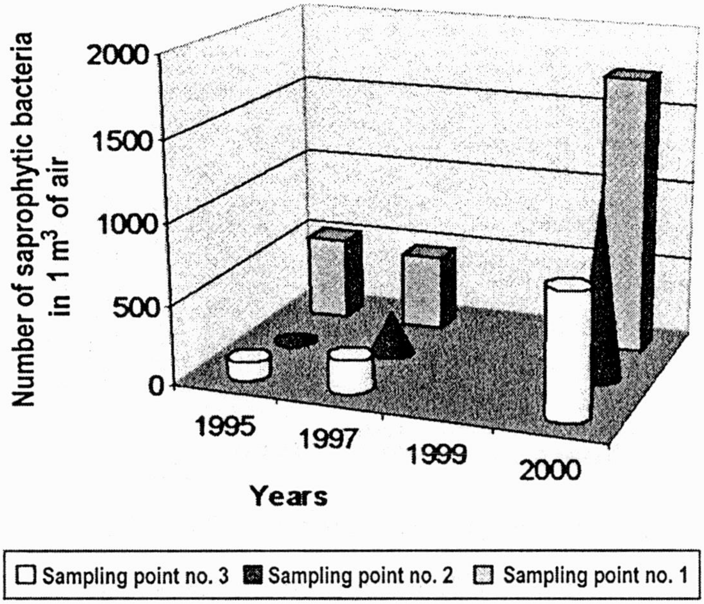

Fig. 4. A total number of saprophytic bacteria in one cubic meter of air
3000 fungi/m^3 – unpolluted air [7]

Table

The concentrations of various pollutants in air [2]

Pollutant	Permissible value [2]	Unit	Value			
			1995 "0"	1997	1999	2000
NH_3	D_{24} =200	μg/m^3	<10	12.5–30.4	<10	39.0
NO_2	D_{24} =100	μg/m^3	15.7–42.5	13.6–42.3	61.3	9.0
H_2S	D_{24} =7	μg/m^3	<0.5	c.b.d.	<2.5	0.0–1.5
CO	D_{24} =3500	μg/m^3	300–800	730–1560	<1000	0.0–1.3
Suspended dust	D_{24} =125	μg/m^3	18.66	26–70	37.4	1.0
Concentrations of metals in suspended dust						
Cr	D_{24} =10	μg/m^3	0.005–0.03	0.013–0.026	0.19	not determined
Zn	D_{24} =20	μg/m^3	0.1–0.15	0.184–0.222	c.b.d.	not determined
Cd	D_{24} = 0.15	μg/m^3	0.002–0.004	0.0045–0.0054	c.b.d.	c.b.d.
Cu	D_{24} =5	μg/m^3	0.05–0.09	0.083–0.126	0.22	not determined
Ni	D_{24} =70	ng/m^3	0.005–0.008	0.006–0.01	c.b.d.	$1.37 * 10^{-4}$
Pb	D_{24} =1.3	μg/m^3	0.068–0.106	0.054–0.144	c.b.d.	c.b.d.
Fe	D_{24} =50	μg/m^3	0.632–0.957	0.925–1.859	2.0	not determined

c.b.d. – the concentration below detectability. The concentrations determined using a spectrophotometer Spektr AA-20 Plus.

3. RESULTS

Operation of such objects as the municipal waste dump presents certain hazards for all components of environment. The quality of ground- and underground water was not deteriorated crucially by this time. Until now only small changes of environment were observed in the vicinity of the dump. Probably they are associated with a season and hydrogeological structure of the land [2].

In the vicinity of the dump, pollution of a soil by heavy metals and the changes in pH value were not observed, hence we could conclude that the pollution was similiar to average contents of those elements in the samples of a basic background (the table).

Migration of heavy metals is considerably limited because the dump reservoir is situated in a characteristic place (in natural mountain valley) and the scrap materials being stored are covered with the layer of soil.

Municipal scrap materials are considered as a local environmental loading because of their characteristic composition, especially the content of organic matter and a considerable quantity of microorganisms (10^8–10^9 in one gram of scrap materials). In biological aerosol, there are the spores of fungi, bacteria, viruses and other microorganisms as well as plant pollen. Waste sediments and hospital scrap materials comprise such specific microorganisms like: *Pseudomonas fluorescens*, staphylococci that induce hemolysis and fungi. If general quantity of bacteria, fungi and saprophytic bacteria increase in the vicinity of waste dump, this proves that those organisms, dangerous for animal and people, are present in the scrap materials.The presence of saprophytic bacteria in the atmospheric air testifies to the process of organic matter decomposition.

The increase in the quantity of fungi (figure 3) means that environment is influenced by the dump. Mould fungi, which are always found in environment, can present a serious threat to people as well as to the fauna and flora.

The research carried out in 1995 demonstrated that a total number of bacteria in 1 m^3 of air varied from 52 to 160, depending upon the measuring point, and a total number of saprophytic bacteria – from 120 to 150. *Escherichia coli* was found in one measuring point only in the quantity of 50/m^3, while *Pseudomonas fluorenscens*, indicator bacterium, was not found in any measuring point.

In the samples from measuring point 1, *Escherichia coli*, *Acinetobacter* and *Bacillus* were isolated.

Such fungi as: *Alternaria*, *Penicillium* and *Mucor* developed in the air forming 1–10 colonies.

In 1997, the total number of bacteria in 1 m^3 of the air varied from 100 to 180, depending on the measuring point, and the quantity of saprophytic bacteria – from 210 to 470. *Escherichia coli* was found in one measuring point only, where its quantity approached 95 microorganism in 1 m^3 of air, while *Pseudomonas* did not occur in any sample. *Acinetobacter* and *Escherichia* were found in the same samples.

Such fungi as *Penicillium*, *Rhinopus*, *Mucor* and *Fusarium* were isolated from the atmospheric air in three measuring points. Their quantity ranged from 290 to 440 in 1 m^3 of air.

In 1999, a total number of bacteria in 1 m^3 of air was 472, and the number of saprophytic bacteria amounted to 865. In one cubic meter of air, there were 1810 fungi. These results proved that the air was unpolluted. However, in the air being analysed, the quantity of *Pseudomonas fluorescens* bacteria approached 263/m^3, which proved that the air was strongly polluted. On the other hand, this kind of bacteria has been always found in groundwater and soil. In the species of *Pseudomonas*, we can find both saprophytic and pathogenic bacteria. *Pseudomonas fluorescens* determined by us belongs to saprophytic bacteria.

Results of the latest research lead to conclusion that a total number of bacteria is still increasing and ranges from 79 to 550 bacteria per 1 m^3 of the air, depending upon measuring point. In 2000, staphylococcus was for the first time found in the second measuring point (52 bacteria/m^3) and in the third measuring point (26 bacteria/m^3).

A total number of fungi increased when being compared to the values from the last years. In 2000, it varied between 2674 and 944 fungi/m^3, depending upon the measuring point. The largest colonies of fungi were found in the point no. 1. Any fungi isolated in the research did not belong to phatogenic species.

The number of saprophytic bacteria in the samples of the air from control points reached 1729 microorganisms/m^3 in measuring point 1 and 788 microorganisms/m^3 in point 3.

In other points, this number increased to 150,000. This proves that in the vicinity of the municipal waste dump, the number of bacteria in the air is relatively small. It should be stressed that in any sample being taken, neither *Escherichia coli* nor mannitolo(+) and mannitolo(–) staphyloccci occurred.

4. RESUMÉ

If we compare the results of microbiological research with the postulated values, we can see that the quality of air deteriorates. In spite of a significant increase in the number of bacteria and fungi per 1 m^3, an excessive pollution of air was not observed. Such a situation is typical of used dumps. According to literature the increase in the amount of microbiological impurities being emitted into the air is considered as natural in a long period of time.

The load of air with microorganisms is still increasing and this can be a signal for the owners of dump that current methods used in order to reduce the influence of this object on environment should be improved. Emission of bioaerosol can be effectively limited if the used parts of a dump area are covered with soil and mineral foam. Moreover, migration of the matter to environment should be limited by a rigorous ban on vehicular traffic in disinfectant padding pod and the use of protective fance for wind and birds.

The screen made of plants of various height will be of a vital importance in environment protection.

The is no a real threat of environment contamination at the end of the first stage of dump exploitation, because the surroundings are uninhabited and unused economically.

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MONITORING ODDZIAŁYWANIA SKŁADOWISKA ODPADÓW KOMUNALNYCH W KRYNICY NA ŚRODOWISKO

Przedstawiono i omówiono wyniki badań zanieczyszczenia powietrza atmosferycznego pochodzącego z bezpośredniego sąsiedztwa składowiska odpadów komunalnych w Krynicy.

Dokonano także porównania najnowszych wyników badań przeprowadzonych w 2000 r. z wynikami badań wcześniejszych, obejmujących zarówno okres oddziaływania składowiska w początkowej fazie eksploatacji, jak i przed jego budową (monitoring zerowy).

Reviewed by Jerzy Chmielowski