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Robert Oleniacz*

# Impact of the Municipal Solid Waste Incineration Plant in Warsaw on Air Quality**

## 1. Introduction

In recent years there have been over 12 million tonnes of municipal waste generated in Poland a year, with about 10 million tonnes a year collected, including only 10% selectively [1]. Among the management methods of collected waste the predominant role is still played by landfilling. According to the statistics, in 2011 about 79% of the mixed municipal waste mass was deposited in landfills, with only 1.1% thereof subject to thermal treatment [1]. The amount of incinerated municipal waste results mainly from the activity of the one and only municipal solid waste (MSW) incinerator in Poland, which is operated since 2000 within the organisational structure of the Municipal Solid Waste Disposal Plant (ZUSOK) in Warsaw.

By 2016 it should, however, be expected that a couple of new MSW incineration plants will have been completed, for which by June 30, 2010 there were applications submitted for subsidies from the Operational Programme Infrastructure and Environment or which will be financed within the Public-Private Partnership [2, 3]. Those facilities will be situated in such cities as Białystok, Bydgoszcz, Konin, Krakow, Szczecin and Poznań. Additionally, there are also plans to modernize the MSW incinerator, operated within ZUSOK in Warsaw which was taken over by "Miejskie Przedsiębiorstwo Oczyszczania (MPO) w m.st. Warszawie Sp. z o.o." on December 2011. Within the framework of planned modernization, first it was decided to build one additional line of incineration in the existing building and then to replace the existing one with another one, a modern installation with comprehensive infrastructure [4, 5]. According to the voivodeship waste management plans developed in 2012, construction of municipal waste incineration plants is planned also for many other Polish cities (after 2015). In most cases these will be regional waste treatment plants.

* AGH University of Science and Technology, Faculty of Mining Surveying and Environmental Engineering, Department of Environmental Management and Protection, Krakow, Poland

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Like the expansion of the ZUSOK MSW incinerator, plans for new MSW incineration plants cause considerable controversy, often resulting in a lack of social acceptance for their implementation. This work presents selected results of the assessment of air quality impact brought about by the MSW incineration unit operated in ZUSOK in Warsaw, carried out for one year of its operation, taking into consideration the results of continuous and periodic emission measurements. Such assessments are rarely published for actual plants and most frequently they focus on the health effects caused by them or on comparing the nuisance stemming from the municipal solid waste incineration plants with other methods of waste management (landfilling with energy recovery, composting etc.) [6–10]. Assessment of air quality impact of a large municipal waste incineration plant, taking into consideration emergency situations, was carried out e.g. by Li [11]. Air pollutant emissions from ZUSOK in Warsaw and their impact on air quality were characterized in [12–13], but in the calculation of atmospheric dispersion of pollutants had been included only the average monthly variability of emission levels. On the other hand, in [14–16] an analogous assessment was placed for the Municipal Solid Waste Thermal Treatment Plant planned in Krakow and for similar MSW incineration plants with a nominal capacity of 250,000 Mg/year of various emitter parameters and locations, but carried out basing on the assumed maximum pollutant emissions to air as stems from the applicable emission limit values or using a different calculation model (Calmet/Calpuff). The assessments of air quality impact of the existing hazardous (including medical) and industrial waste incineration plants as well as waste co-combustion installations based on cement kilns are presented e.g. in [17–19]. Those assessment indicate that the existing waste incineration and co-combustion plants emitting pollution lower than the applicable emission limit values do not cause any significant deterioration of air quality. Relatively, the highest concentrations in air in relation to the permissible levels are caused by emissions of nitrogen oxides. For all the other substances, the concentrations in air are many times lower than the respective reference values or background values in a given region.

## 2. Characteristics of the Study Object

ZUSOK is located in Warsaw, in the industrial part of the district Targówek. The nearest dense residential development (low and medium) is just over 1 km from the plant. Its activity is focused on by-product recovery from municipal solid waste, the thermal treatment of the combustible fraction of waste (energy recovery), the processing of ash and slag produced during the incineration process to convert them to aggregate, and the composting of organic waste. The basic parameters of ZUSOK in Warsaw (including the MSW incinerator) are provided in Table 1.

Municipal solid waste is transported to the plant by trucks and unloaded to a closed sorting bunker from which it is taken by a multi-purpose grab to the

preliminary segregation line [12, 20]. First, the waste goes to the loading table with a sliding floor and then, via a chain conveyor, it is taken to the trough screen where it is separated in two fractions: up to 300 mm and above 300 mm. Those two fractions are transported by conveyors to the sorting cabin where manual waste segregation takes place. The following are removed: glass bottles, ferrous metals, ballast (e.g. construction debris) and hazardous waste (e.g. chemicals, paint and aerosol containers, batteries, etc.).

**Table 1.** Basic operating parameters of the Municipal Solid Waste Disposal Plant (ZUSOK) in Warsaw

| Parameter | Unit | Value |
|---|---|---|
| Designed output of the system for segregating mixed municipal waste | Mg/year | 128 000 |
| | Mg/d | 420* |
| Current output of the plant | Mg/year | about 70 000** |
| Typical amount of waste received | Mg/year | 60 000–65 000 |
| Maximum amount of waste received at a time | Mg/d | 800 |
| Maximum amount of composted waste | Mg/d | 210 |
| Maximum amount of ripe compost | Mg/d | 45 |
| Maximum amount of incinerated waste (furnace capacity) | Mg/year | about 42 000 |
| | Mg/d | 181 |
| | Mg/h | 7.54 |
| Average amount of incinerated waste | Mg/year | about 40 000 |
| | Mg/d | about 130 |
| Average amount of slag generated | Mg/d | about 36 |
| Average furnace (incineration line) operating time | h/year | about 7 500 |
| Maximum/rated boiler effectiveness | Mg/h of high-pressure steam | 17 / 15 |
| Maximum/average electricity production | MWh/year | 14 000 / 10 500 |
| Maximum/average heat production | GJ/year | 280 000 / 240 000 |
| Electricity production coefficients:<br>before launching the heating unit<br>basic work of the heating unit<br>sub-peak work of the heating unit | kWh/Mg of waste | <br>345<br>290<br>230 |
| Heat production coefficients:<br>basic work of the heating unit<br>sub-peak work of the heating unit<br>peak work of the heating unit*** | GJ/Mg of waste | <br>5.9<br>6.3<br>6.9 |

* 2-shift work
** total output of the sorting house, composting house and incineration plant in a single process line
*** only heat generation

Source: [12, 20, 22]

The waste from the sorting cabin is then passed into two mechanical segregation lines. The bulky waste (fraction above 300 mm) is first shredded into hammer mills. Crushed waste from the mills and fraction below 300 mm, following a preliminary segregation, is fed to rotary screens with mesh sized 20 mm and 50 mm. The fines (fraction below 20 mm) is taken to a gravity separator, aimed at increasing the amount of reclaimed organic substances and selecting fine glass and neutral substances to be deposited in a landfill. The medium fraction (20–50 mm) from the screens and the gravity separator, composed of organic materials, is transported to the magnetic belt separator where all ferrous metals are removed and then to the composting house where the composting process according to Italian SILODA technology takes place. The screenings (fraction above 50 mm) are flammable fraction designed for incineration which via belt conveyors goes to a storage bunker of the furnace [12].

The waste incineration process takes place in a grate furnace with a reciprocating grate manufactured by Danish company called Krüger, with the capacity of about 7.54 Mg/h, with a waste-heat boiler with the efficiency of 74.5% (Fig. 1) [20]. Waste incineration time on the grate ranges from 30 to 120 minutes, and the flue gas retention time in areas with temperatures of 850–1150°C is at least 2 s. In this boiler steam is generated to supply a steam turbine unit producing electricity and after passing through the turbine, the steam is additionally utilised in the boiler water degassing process, and for heating purposes (after being directed to the heating power unit system consisting of two water/steam plate heat exchangers with integrated condensate coolers with a power of 10 MW). The flow of water used by municipal recipients ranges from 143.4 Mg/h to 330.7 Mg/h, depending on the parameters required by the recipients (supply and return temperature) [21].

Air pollutant emissions are reduced in many stages by the successive (Fig. 1): the injection of ammonia water into the space of the waste heat boiler in the area with temperatures of 850–950°C for reducing nitrogen oxides (SNCR method), the feeding of dry sorbent (hydrated lime) into the flue gases before the fabric filter (through static mixer) to sorption of acidic gaseous pollutants (sulphur oxides, hydrogen chloride and hydrogen fluoride) on the filter surface, the dedusting of flue gases and the retention of the sorbent in the fabric filter, and the adsorption of remaining contaminants (including heavy metals, and polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs)) by means of activated coke in a WKV-type counter-current reactor (adsorber) [13]. Used-up active coke is automatically removed from the lower part of the adsorber and transported to sealed containers from where it is periodically (once every two days) collected and treated thermally by co-incineration in a grate furnace together with other waste. Its mass is about 0.36% of the total incinerated waste mass [12]. Treated flue gases are released to air by a chimney 80 m high with a diameter of 1.62 m.

Pollutant emissions to air from the studied incinerator is monitored continuously and periodically using reference measurement methods in compliance with the applicable regulations [23, 24]. Within the continuous monitoring system the

following are used, e.g. multi-gas analysers of GASMET CX-4000 (FTIR) and SICK MAIHAK MCS 100E HW (IR) type, VOC (TOC) analyser of JUM 3-700 type (FID), optical dust meter DURAG DR 300-40 (calibrated gravimetrically) and flow meter of DURAG D-FL 100 type (pressure difference measurement) [12].

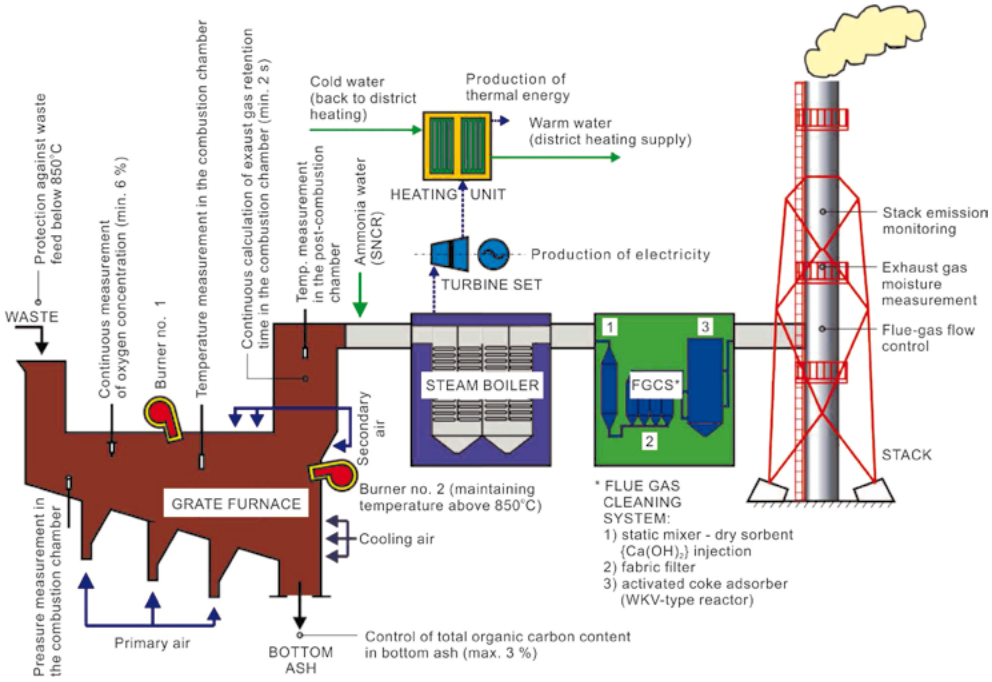


**Fig. 1.** Demonstrative diagram of the MSW incineration plant working within the ZUSOK in Warsaw

Source: own work based on [20]

## 3. Research Methods

Air quality impact assessment for the studied MSW incineration plant was carried out by assessing emission of monitored pollutants to the air, and based on performed calculations the dispersion of those pollutants in the atmosphere.

Assessment of the air emissions was based on analysing the results of continuous and periodic measurements of polluting substance concentrations in gases emitted to air in the selected period, i.e. in 2008 [25, 26], in reference to the current applicable emission limit values [24, 27]. With respect to the incinerated waste amounts and emission levels, the analysed period can be considered typical for this plant.

Currently, ZUSOK in Warsaw annually receives about 60–70 thousand tonnes of municipal solid waste, of which about 60–65% of the mass is incinerated [4, 12, 18]. For example, in 2008 ZUSOK received 63,025 Mg of waste (including 62,697 Mg of

mixed municipal waste) to recover and dispose of 39,729 Mg of this waste were incinerated [13].

For the flue gas parameters (temperature and speed of the outlet) and substances monitored on a continuous basis (total dust, HF, HCl, $SO_2$, CO and $NO_x$), in the calculation of atmospheric dispersion were included actual average monthly data for one year and also emission duration in a given month. In months where periodic measurements were made, the results of these measurements were also presented in the form of additional emission variants. For substances measured only periodically, twice a year (HF, heavy metals, dioxins and furans), emission in a given half-year period was assumed as constant, basing on the measurement result obtained.

The pollutant dispersion in the air was calculated using the Gaussian Plume, based on atmospheric equilibrium states and diffusion coefficients according to Pasquill [28]. For this purpose, the so-called reference method of modelling substance level in air was used [29–31], routinely applied in Poland for environmental impact assessments also for waste incineration plants [32].

In the calculations were included representative of the Warsaw region long-term statistics of meteorological data (including wind roses) divided into winter and summer seasons (Fig. 2) [33] and the average surface aerodynamic roughness length designated for the assumed calculation area at the level of $z_o$ = 1.3 m.

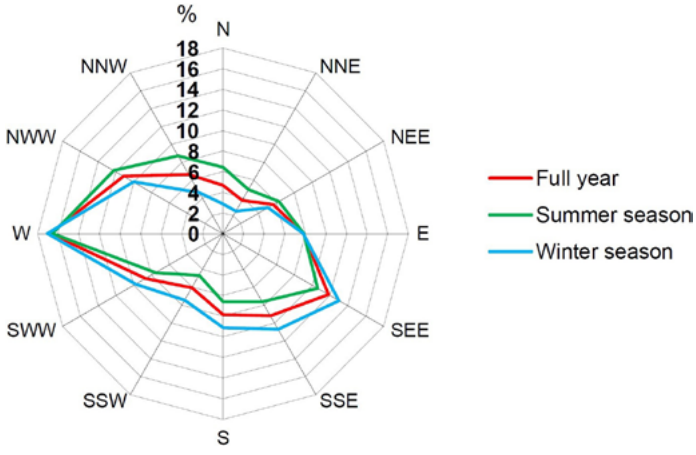


**Fig. 2.** Multiyear wind rose for the Warsaw region

Source: own work based on [33]

For particular substances the following calculations were carried out:

- highest maximum concentrations in the air at ground level,
- concentrations in a regular grid of calculations points on the ground (in the area with the size of 8 (8 km and a resolution of 250 m),
- concentrations at the height of the nearest residential and public buildings, and higher.

The calculation results were compared with applicable permissible levels [34], reference values [31] or background values for certain substances in the air, stemming from direct measurements.

## 4. Results

### 4.1. Assessment of Air Pollutant Emissions

Variability of the monthly average (for continuous measurements) or several-hours average (for periodic measurements) concentrations obtained in the analysed period (2008) for particular pollutants in gases emitted to the air was presented in reference to appropriate emission limit values (permissible levels) [24, 27] in Figure 3.

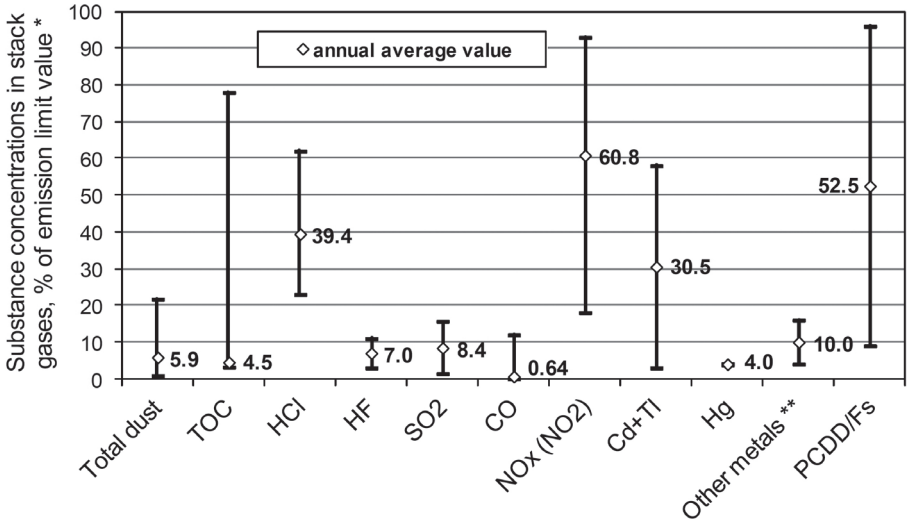


**Fig. 3.** Variability of pollutant concentrations in gases emitted to air from the ZUSOK MSW incinerator in 2008 when compared to emission limit values

* daily average standard (for total dust, TOC, HCl, HF, $SO_2$, CO and $NO_x$) or for sampling period (heavy metals and PCDD/Fs) [24, 27]
** total Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V

For all substances which are obligatorily monitored for their emission to air from similar plants, the average and maximum concentrations were lower than the emission standards for those substances in an averaging time from 30 minutes to 24 hours (Fig. 3). The lowest annual average concentrations in the emitted gases (of 1–10% of respective emission standards) were detected for total dust TOC, HF, $SO_2$, CO and most heavy metals. Relatively high pollutant concentrations (still below emission limit values) were observed for nitrogen oxides ($NO_x$), hydrogen chloride

(HCl) and polychlorated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs). For example, the maximum one-hour concentrations of $NO_x$ and HCl, discovered in periodic measurements carried out in the analysed period [26], were obtained at the level of 186 mg/m$^3$ and 6.2 mg/m$^3$ respectively (at reference conditions: the pressure of 101.3 kPa, the temperature of 273.15 K, dry gas, 11% $O_2$) which represents 93% and 62% respectively of the average daily emission limit values and 47% and 10% respectively of the half-hourly emission standard for those substances. The maximum concentration of PCDD/Fs in the emitted gases was measured to reach 0.096 ngTEQ/m$^3$ (at reference conditions) which stands for 96% of the emission limit value being 0.1 ngTEQ/m$^3$. The result of the second measurement carried out the same year was much lower (0.009 ngTEQ/m$^3$, or only 9% of the permissible value) which proves significant variations of those concentrations in waste gases. The significant variability of concentrations in the emitted gases was found also for TOC which is corroborated e.g. by the fact that the monthly average concentrations are very high (usually below 0.5 mg/m$^3$) while short-term concentrations can reach even 8 mg/m$^3$, that is 80% and 40% respectively of the daily average and half-hourly emission limit value.

Basing on the results of the continuous and periodic measurements, there was also assessment of the air emission level variability in the analysed year. The monthly average emissions of substances monitored continuously were presented in Figure 4 while emission duration (incineration plant operation) in particular months – in Figure 5. In turn the results of the periodic emission measurements for particular substances are presented in Table 2.

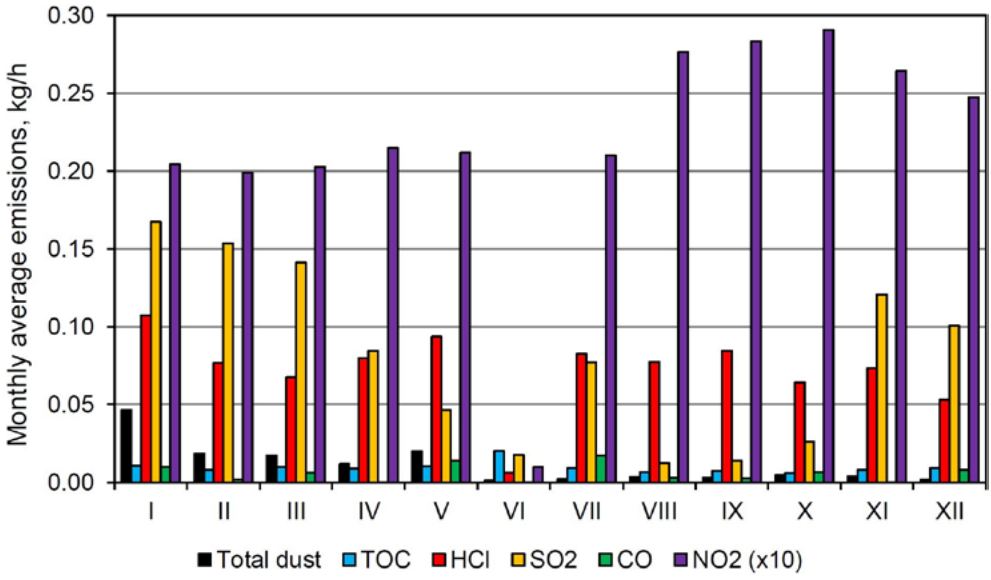


**Fig. 4.** Variability of the monthly average pollutant emissions to air from the ZUSOK MSW incinerator in 2008

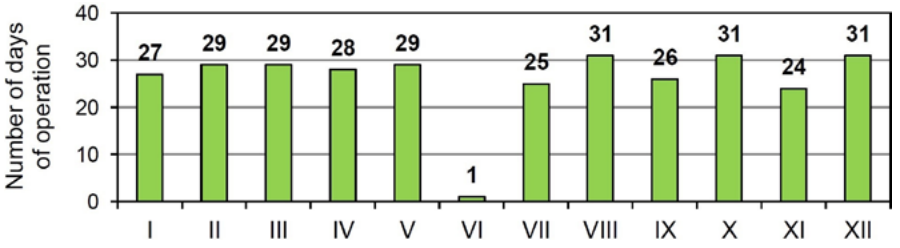


**Fig. 5.** Number of days the ZUSOK MSW incinerator operated in 2008

**Table 2.** Results of periodic measurements of air emissions carried out in the ZUSOK MSW incinerator in 2008

| Substance | Unit | Emission | | |
|---|---|---|---|---|
| | | I half-year | II half-year | mean |
| TOC | kg/h | 0.039 | 0.147 | 0.093 |
| HCl | kg/h | 0.058 | 0.117 | 0.087 |
| HF | kg/h | 0.0023 | 0.0006 | 0.0015 |
| Total dust | kg/h | 0.0103 | 0.0094 | 0.0099 |
| $NO_x$ ($NO_2$) | kg/h | 3.82 | 2.99 | 3.41 |
| $SO_2$ | kg/h | 0.062 | 0.075 | 0.068 |
| CO | kg/h | 0.123 | 0.094 | 0.109 |
| Cd | g/h | 0.596 | 0.028 | 0.312 |
| Tl | g/h | 0.0039 | 0.0004 | 0.0022 |
| Hg | g/h | 0.041 | 0.038 | 0.039 |
| Sb | g/h | 0.0019 | 0.0077 | 0.0048 |
| As | g/h | 0.0017 | 0.0028 | 0.0023 |
| Pb | g/h | 0.226 | 0.021 | 0.123 |
| Cr | g/h | 0.066 | 0.119 | 0.092 |
| Co | g/h | 0.0025 | 0.0006 | 0.0016 |
| Cu | g/h | 1.33 | 0.10 | 0.72 |
| Mn | g/h | 0.023 | 0.028 | 0.025 |
| Ni | g/h | 0.074 | 0.010 | 0.042 |
| V | g/h | 0.0025 | 0.0053 | 0.0039 |
| Sn | g/h | 0.0047 | 0.0047 | 0.0047 |
| PCDDF/s | µgTEQ/h | 0.18 | 2.04 | 1.11 |

Source: [26]

According to the presented data (Tab. 2), the monthly average emissions of total dust, TOC, HCl, $SO_2$ and CO ranged from less than ten to 170 g/h. $NO_x$ emissions (expressed as $NO_2$) usually were about 2–3 kg/h, and the maximum emission obtained in periodic measurements did not exceed 4 kg/h. In the analysed year the incineration plant operated for 311 days, with a longer downtime in June and early July. The average emission for June, presented in Figure 4, refers solely to 1 day of plant work and reflects an abnormal situation, connected with furnace stopping

(stopped waste supply, gradual reduction of flue gases generated, increased excess air and furnace blow-out). On that day, therefore, much lower (when compared to the ordinary system operation) emissions to air of all substances monitored continuously were observed, except for TOC.

### 4.2. Assessment of the Air Quality Impact

The list of maximum concentrations in the air at ground level for particular pollutants, obtained from the calculations carried out, is presented in Table 3. The spatial distribution of maximum one-hour and annual average concentrations in air for selected substances is presented in Figures 6–7 (along the computing axis coinciding the dominant wind direction) and in Figures 8–9 (for the basic calculation area of dimensions 8 (8 km).

**Table 3.** Comparison of the calculation results of the highest maximum ($C_{mm}$) and annual average ($C_{a\,max}$) of substances in the air at ground level with appropriate reference values

| Substance | Unit | Highest concentration* | | Reference value (substance background)** | |
|---|---|---|---|---|---|
| | | $C_{mm}$ | $C_{a\,max}$ | $D_1$ | $D_a$ ($R$) |
| $PM_{10}$ | µg/m³ | 0.10 | 0.00054 | 280 | 40 (32.1) |
| TOC | µg/m³ | 0.67 | 0.00077 | – | – |
| HCl | µg/m³ | 0.53 | 0.00704 | 200 | 25 |
| HF (as F) | µg/m³ | 0.013 | 0.00012 | 30 | 2 |
| $SO_2$ | µg/m³ | 0.72 | 0.0077 | 350 | 20 (11.3) |
| CO | µg/m³ | 0.54 | 0.00045 | 30 000 | (463) |
| $NO_2$ | µg/m³ | 16.7 | 0.215 | 200 | 40 (25.6) |
| Cd | ng/m³ | 1.75 | 0.0090 | 520 | 10 |
| Tl | ng/m³ | 0.011 | 0.00009 | 1 000 | 130 |
| Hg | ng/m³ | 0.242 | 0.00356 | 700 | 40 |
| Sb | ng/m³ | 0.018 | 0.00023 | 23 000 | 2 000 |
| As | ng/m³ | 0.006 | 0.00011 | 200 | 10 |
| Pb | ng/m³ | 0.664 | 0.00523 | 5 000 | 500 |
| Cr (as $Cr^{+6}$) | ng/m³ | 0.270 | 0.00428 | 4 600 | 400 |
| Co | ng/m³ | 0.007 | 0.00007 | 5 000 | 400 |
| Cu | ng/m³ | 3.92 | 0.0303 | 20 000 | 600 |
| Mn | ng/m³ | 0.066 | 0.00116 | 9 000 | 1 000 |
| Ni | ng/m³ | 0.217 | 0.00178 | 230 | 25 |
| V | ng/m³ | 0.012 | 0.00018 | 2 300 | 250 |
| Sn | ng/m³ | 0.014 | 0.00021 | 50 000 | 3 800 |
| PCDD/Fs | fgTEQ/m³ | 4.65 | 0.054 | – | – |

* $C_{mm}$ – highest maximum one-hour concentration in the calculation area assumed
$C_{a\,max}$ – highest annual average concentration in the calculation area assumed
** $D_1$ – reference value in air averaged for one hour [31]
$D_a$ – reference value in air averaged for one calendar year [31]
$R$ – background substance value assumed as the annual average concentration in air at the nearest automatic air monitoring station (Warsaw-Targówek) in the analysed period (2008) [35]

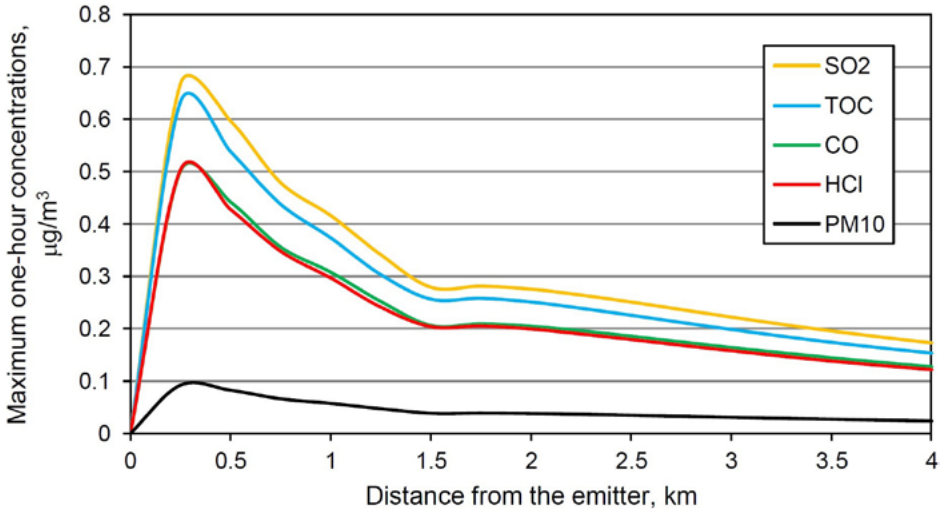


**Fig. 6.** Distribution of maximum one-hour concentrations in air at the ground for selected substances versus the distance from the emitter (axis towards the East)

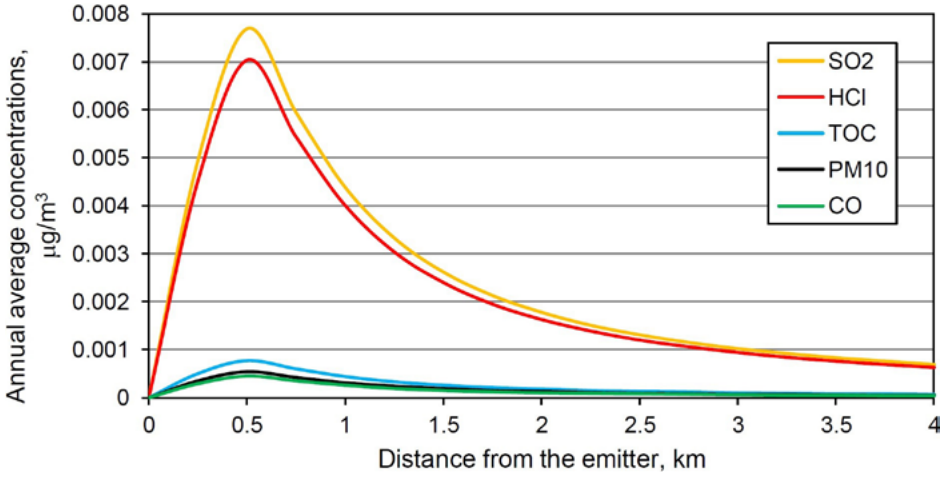


**Fig. 7.** Distribution of annual average concentrations in air at the ground for selected substances versus the distance from the emitter (axis towards the East)

As stems from Table 3, the highest maximum one-hour and annual average concentrations caused by the municipal waste incineration plant in Warsaw at ground level are many times lower than the respective reference values (permissible ones) and background values for those substances in the air determined for this part of the city. Relatively, the highest concentrations when compared to the permissible values were obtained for maximum one-hour $NO_2$ concentrations in the air. The maximum values of those concentrations did not exceed 10% of one-hour permissible level ($D_1$).

The maximum annual average $NO_2$ concentrations for the regular calculation grid were obtained at the height of only 0.5% of the annual average permissible level ($D_a$) and 0.7% of the background value for this substance in air ($R$). Equally low concentrations were found for calculations carried out at the height of the nearest residential and public buildings (buildings of 1–4 floors) [12].

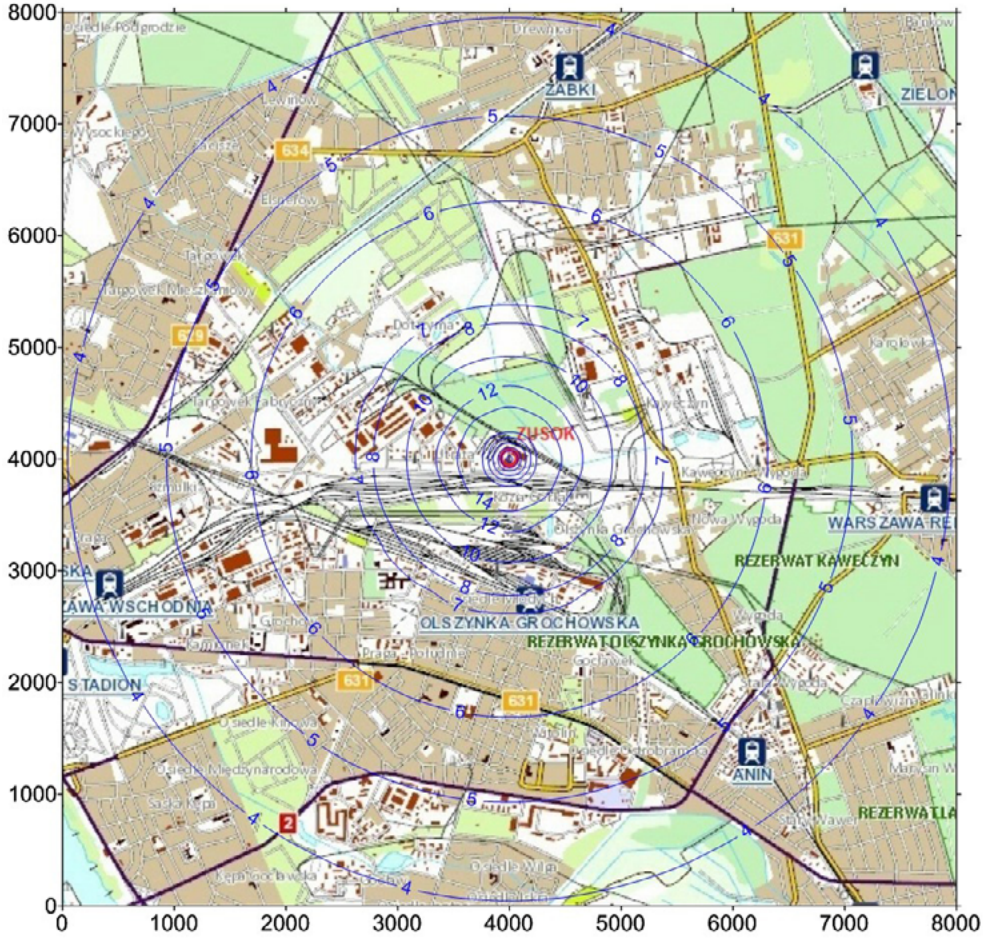


**Fig. 8.** Spatial distributions of maximum one-hour $NO_2$ concentrations in air at the ground [μg/m$^3$]

For the remaining substances studied the calculation results for their concentrations in the air at ground level and at the height of the nearest building reached far below 1% of the respective permissible level or reference value (at least 300 times lower for maximum one-hour concentrations and over 1000 times lower for maximum annual average concentrations).

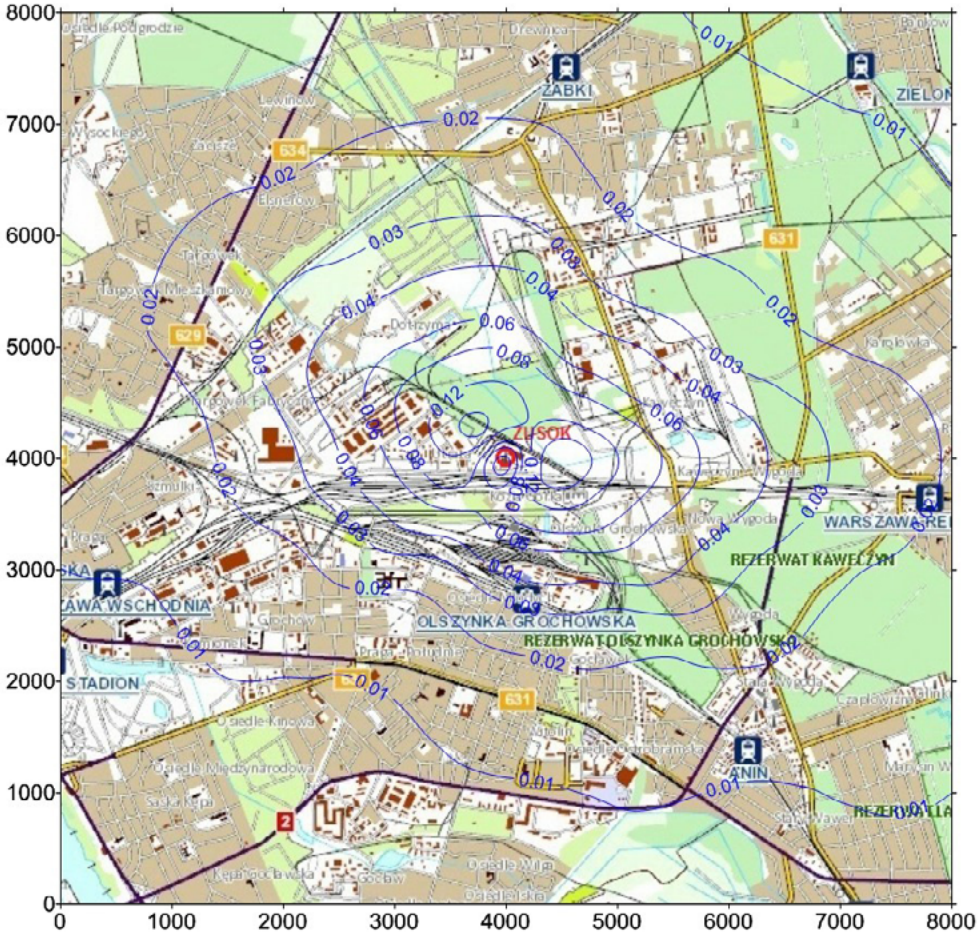


**Fig. 9.** Spatial distributions of annual average $NO_2$ concentrations in air at the ground [μg/m$^3$]

Very small concentration values compared to their typical concentrations observed in urban and rural areas [36–40] were also obtained for the substances for which no reference values in air (e.g. PCDD/Fs) are set. For example, the mean PCDD/Fs concentrations determined for the urban (based on the measurement results from 24 various towns of the world) and rural (eight locations) backgrounds amount to 157 fgTEQ/m$^3$ and 30 fgTEQ/m$^3$, respectively [36]. These values being respectively 33 and 6 times larger than the highest maximum one-hour concentrations obtained for the incineration plant under consideration.

The highest maximum concentrations in air are usually connected with the presence of the maximum emission variant (determined basing on the analysed continuous or periodic measurement results) and with the most adverse meteorological situation

(here the unstable equilibrium state and wind speed of 1 m/s). The spatial distributions of average annual concentrations largely reflect the major directions of pollutant dispersion, stemming from the wind rose characteristic of this area (Fig. 2). The maximum concentration values are observed at about 250–300 m from the emitter for maximum one-hour concentrations (Figs 6, 8) and about 500 m to the East and North-West from the emitter for the maximum annual average concentrations (Figs 7, 9).

Although there are virtually no high-rise buildings in this region, there were additional calculations carried out to study the changes of the maximum concentrations caused higher, at a distance of 100, 200, 300, 400 and 500 m from the emitter. The results of those calculations for maximum one-hour $NO_2$ concentrations are presented in Figure 10. They indicate a slight increase in pollutant concentrations at the height of 30 m above the ground, especially for points located more than 200 m from the emitter. This means that even if there were any 10-floor buildings located 500 m from the emitter, the impact of emission from the analysed waste incineration plant on air quality at higher floors would not be much different than the one detected at the ground. More significant concentration increase versus height can take place in the immediate vicinity of the emitter (up to 200 m) and for heights exceeding 30 m above the ground.

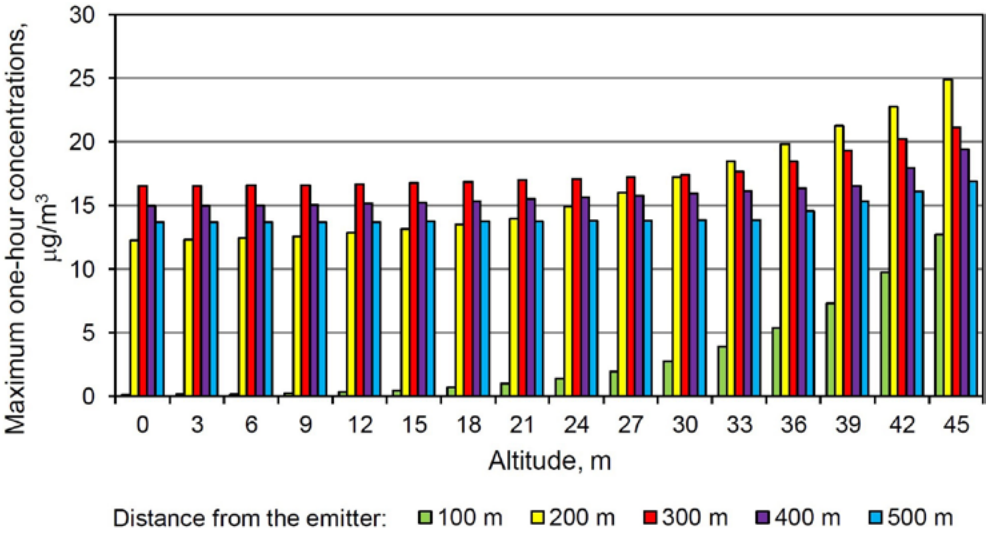


**Fig. 10.** Vertical variability of maximum one-hour $NO_2$ concentrations in air for points located 100–500 m from the emitter

## 5. Conclusions

Basing on the air quality impact assessment, carried out for the only Polish MSW incineration plant in relation to the representative, one-year period of its operation (2008), the following conclusions were drawn:

1. The MSW incinerator operated within ZUSOK in Warsaw is a negligible source of air pollutant emissions and causes minor air pollution within its range.
2. Pollutant concentrations in gases emitted to air usually remain many times lower than the applicable emission limit values, especially for total dust, TOC, HF, $SO_2$ and heavy metals.
3. Relatively highest air emissions when compared to the permissible level are observed for $NO_x$, PCDD/Fs and HCl. In the analysed period they reached about 40–60% of the respective emission limit values (expressed as a daily average or a the sampling period), with maximum values not exceeding those emission standards.
4. The calculations of pollutant dispersion in air, carried out for the analysed MSW incinerator, reveal that their concentrations in air are many times lower (frequently by several orders of magnitude) than the applicable permissible levels or reference values for a given substance, and also than the background values of certain substances in air, determined basing on the measurement results at the automatic air monitoring station for Warsaw-Targówek ($PM_{10}$, $SO_2$, CO and $NO_2$) [35] as well as the results of measurements typical for urban and rural areas (PCDD/Fs) [36–40].
5. The results of the calculated pollutant concentrations in the air, carried out at the nearest buildings and also a bit higher (up to 30 m) reveal a slight increase of them versus height when compared to the results at the ground.
6. Planned the increase processing capacity of ZUSOK in Warsaw being several times higher than now should not have any significant impact on air quality, provided the emission limit values are retained which is confirmed e.g. by the calculations for the currently constructed Municipal Waste Thermal Treatment Plant in Krakow [14–16].

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