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ESTIMATING ODOUR IMPACT RANGE OF SELECTED WASTEWATER TREATMENT PLANT FOR WINTER AND SUMMER SEASONS IN POLISH CONDITIONS USING CALPUFF MODEL

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OBJECT OF THE STUDY

The analyzed object is mechanical biological wastewater treatment plant with intensified nutrients removal and full sludge treatment, designed for 1200000 population equivalent. It has been the object of local community complaints due to odour nuisance. Taking into account results of olfactometric analyses and field inspections, sources as primary clarifiers and thermal drying plant have been selected for further WWTP odour impact assessment. It was assumed that every source emits one specified mixture of odorants, which is considered as an individual type of odour.

Emission source	Type of source	Odour concentration ($ou_E\ m^{-3}$)	SOER ($ou_E\ m^{-2}\ s^{-1}$)	OER ($ou_E\ s^{-1}$)
primary clarifiers	area-passive	11130	835	7089618
thermal drying plant	area-active	19916	-	44636

Table 1. Odour emissions from selected sources

SITE DESCRIPTION

The study was conducted on an area of western Poland, comprising two big villages (about 15 000 inhabitants), which are located just a few kilometers from a city of over 500 000 inhabitants. Analyzed site consists of industrial, residential as well as agricultural areas. WWTP and industrial facilities are located in Warta river valley. The study focuses on estimating odour impact of WWTP to residential areas which are situated in eastern and northeastern part of the site. Topography of the site is quite complex. Only small part of residential areas are located in the river valley, most of them lies on the hills in the eastern part of the site.

Fig. 1. Site of the study

SAMPLE COLLECTION AND ANALYSES

Odour samples were collected using vacuum sampler to special purpose sampling bags made of PTFE, which do not absorb or emit odours. Other elements of the sampling kit are also made of odourless materials, which does not absorb odours. Following the recommendations, bags have been previously conditioned. Collection of the samples is based on lung function principle. Sampling on area sources was performed using special 1 m x 1 m cover for active sources (i.e. biofilters) and wind tunnel manufactured by ECOMA for passive sources (i.e. liquid surfaces without outward flow, e.g. primary clarifiers). Wind tunnel used is made as stainless steel hood with two electric fans which induce constant air flow under the hood. Base area of the hood is 0,5 m^2

Fig. 2. Vacuum sampler

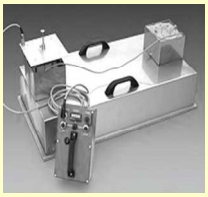

Fig. 3. ECOMA windtunnel

Fig . 4. Dynamic olfactometer TO8

WIND CONDITIONS

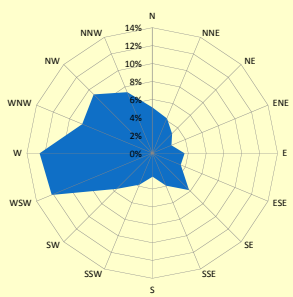

Fig. 5. Wind rose for analyzed site - May

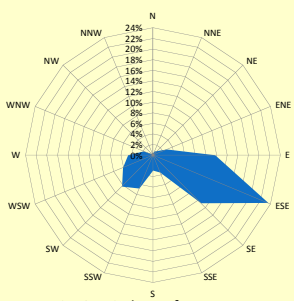

Fig. 6. Wind rose for analyzed site - November

The calculations using the CALPUFF model has been carried out for summer (July) and winter (November) seasons what allowed to assess odor impact range of analyzed WWTP for different meteorological conditions and to determine the shape and spatial variability of odor plume. Calculations has been made for six day periods (144 hours). Input emission rates shown in table 1 were constant for both seasons. For modeling purposes two groups of meteorological data has been provided: data from ground stations (wind speed and direction, cloud height, cloud cover, air temperature, relative humidity, atmospheric pressure) and soundings data from aerological stations (atmospheric pressure altitude, air temperature, wind speed and direction with altitude at which they occurre). Model calculations were conducted for the grid size 3 x 5 km, which includes neighboring residential areas, which are exceptionally exposed to odours.

RESULTS OF CALPUFF MODEL CALCULATIONS

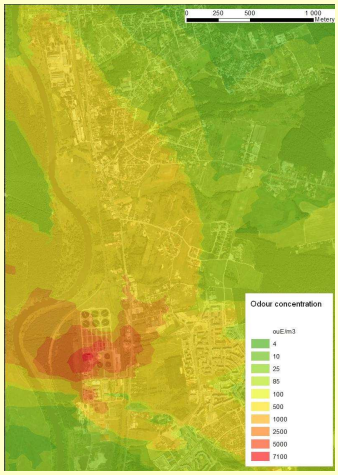

Fig. 6. Maximum odour concentration - primary clarifiers, summer season

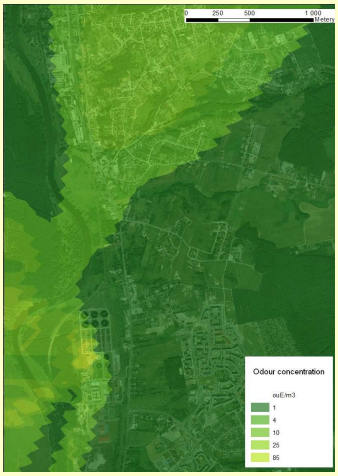

Fig. 7. Maximum odour concentration – primary clarifiers, winter season

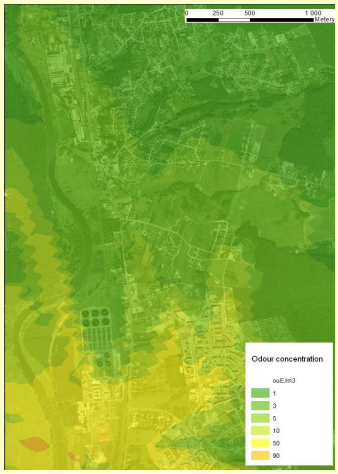

Fig. 8. Maximum odour concentration - thermal drying plant, summer season

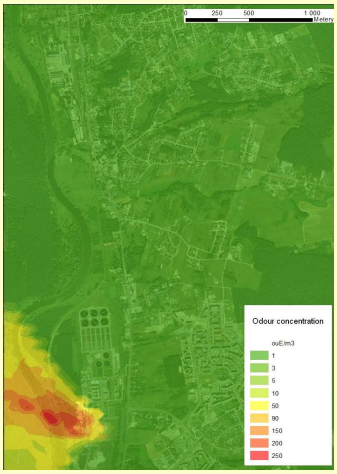

Fig. 9. Maximum odour concentration - thermal drying plant, winter season

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