ADVERSE EFFECTS INDUCED BY ACTIVITIES DEVELOPED IN THE MUNICIPAL WASTEWATER TREATMENT PLANTS IN THE PROXIMITY AREAS

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Abstract
Among the many environmental problems facing the society one of the most important is undoubtedly a municipal wastewater treatment. Municipal wastewater treatment plant removes the pollutants from urban wastewater composed of a mixture of domestic wastewater or domestic wastewater mixed with industrial wastewater and / or pluvial waters runoff. Wastewater treatment is beneficial by solving a series of problems that affect the environment but in some cases, contributes to the generating an environmental impact near the sites, considering that policy instruments are improperly applied. The paper presents the results of investigations carried on the quality of soil and water in the areas surrounding of the two municipal wastewater treatment plants, chosen as case studies, from different regions of the country. For those have been achieved diagrams representing the state of pollution in the selected areas. The impact assessment induced in the vicinity of the activities carried out in sewage treatment plants was achieved by interpreting the results of investigations in compliance with specific legislation

Keywords*: areas, assessment, pollution, proximity, wastewater treatment plants*

1. Introduction

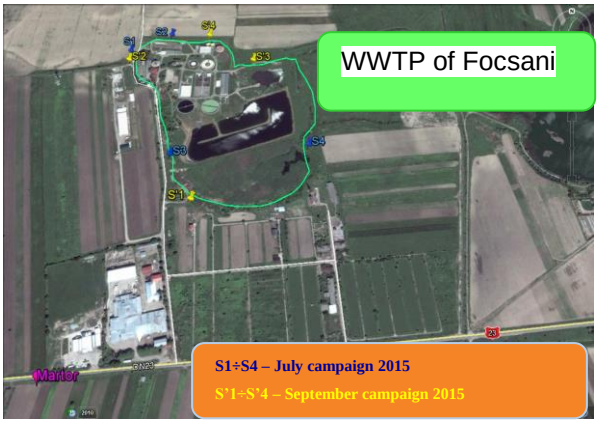
Problem of quality and environmental protection came into actuality as the world has become aware of the need for conservation and more efficient use of the productive potential of the environment. Therefore both global and national attention is given increasingly higher environmental activities and supervision of changes to the quality [1].
The activities of the municipal wastewater treatment plants are authorized in terms of environmental protection in accordance with environmental legislation specifies [2].
The activities developped by adverse conditions in a municipal wastewater treatment plants can sometimes lead to deterioration of the quality environmental components of the site and can be extended in their proximity.
Negative effects induced on the quality of environmental factors that can extend and proximity sites are generated by: the occurrence of sections of damaged sewerage system wastewater collectors, the discharge of insufficiently treated in natural emissary, diffuse emissions from the handling of powdery substances and products or volatility, etc.
Nationwide, as a result of the enforcement of environmental permits, quality monitoring is done in site environmental components [3], but it not enough however highlighted the effects that may occur in the vicinity of the sites.

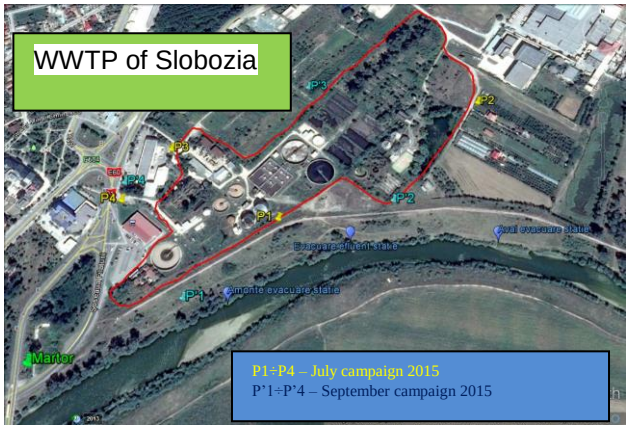
2. Materials and Methods (or **Experimental**)

It was followed analysis of two wastewater treatment plants with different particularities in different development regions of Romania selected as case studies: South-East Region 2 - WWTP of Focsani and South Muntenia Region 3 - WWTP Slobozia.
Measuring the impact of induced by the activities carried out in the two treatment plants in proximity locations was conducted in two campaigns seasonal: summer and autumn.
For both municipal wastewater treatment plants (Focsani and Slobozia) methodology was applied to investigate the environmental component soil, wastewater and surface water quality, as follows [4]:
a) The investigation of field was achieved by:
- direct observations during visits to sites
- identifying how to use the land in the vicinity of the stations
- defining the experimental field, respectively establish the locations of sampling soil and water
- sampling and appropriate conservation
- registration of the geographical position of sampling points
b) Laboratory investigation was carried out by:
- characterization of soil and water samples taken in terms of global and specific indicators
- applying standardized test methods for determining quality indicators select and use of the latest generation analytical equipment

In the *investigation field activities* for each of the treatment plant were established sampling locations outside the site boundary. They were distributed in order to cover a larger area, thus defining the experimental field. We used a manual drilling equipment, Eijkelkamp probe, samples are collected in glass jars, with lids tightly closed. The soil samples were taken from each neighborhood treatment plants, from 0-10 cm and 30-40 cm in profile each having 8 / location.
Investigation of water quality has been achieved by taking in each location, discharge water into the station and surface water samples (emissary receptor effluent treatment station - Putna river where wastewater treatment plant in Focsani and Ialomita river where wastewater treatment plant Slobozia), upstream and downstream of the point of discharge of the effluent station. Sampling of water (wastewater and surface) were used telescopic equipment type scooper.
The geographic location of all sampling points was achieved with a Garmin GPS receiver.
During the *investigation in laboratory activities* for each treatment plant, we were determined the quality indicators:
- for soil samples: pH, wet, organic carbon, total nitrogen, ammonium, chloride, total phosphorus, sulphates, nickel, zinc, iron, copper, cadmium
-for water samples: pH, COD, BOD, ammonia, total nitrogen, total phosphorus, nitrates, chlorides, sulfides, filterable residue, nickel, copper, zinc, iron, cadmium.
For WWTP Focsani: July samples are denoted S1÷S4 and the September S'1÷S'4.
For WWTP Slobozia: July samples are denoted P1÷P4 and the September P'1÷P'4.

Location of sampling points is shown in the following figures.





3. Results and Discussion

The results of characterization of soil samples taken from both neighborhoods treatment plants are presented in Tables 1, 2, 3, 4 and the characterization of water samples are presented in Tables 5.6.

Table 1 Characterization of soil samples near the wastewater treatment plant of Focsani - July 2015 campaign

Quality Indicator	Sample									
	S1/1	S1/2	S2/1	S2/2	S3/1	S3/2	S4/1	S4/2	M/1	M/2
pH	7,22	6,94	6,93	7,05	6,87	6,89	7,2	7,05	6,53	6,95
wet, %	14,8	15,11	6,48	7,17	10,99	12,43	8,51	9,06	13,35	15,12
C organic, %	0,28	0,57	0,3	0,21	0,11	0,3	0,15	0,22	0,06	0,07
Total nitrogen, % d.s.	0,201	0,191	0,202	0,176	0,232	0,213	0,195	0,198	0,159	0,151
Ammonium, mg/kg d.s.	19,92	18,05	21,21	18,85	16,79	16,14	18,20	17,96	20,97	20,02
Chloride, mg/kg d.s.	33,33	31,81	30,36	22,94	39,88	36,48	32,56	35,64	32,77	30,18
Sulfati, mg/kg d.s.	109,15	177,87	152,9	157,27	221,32	134,74	127,5	135,12	216,96	146,08
Total phosphorus, % d.s.	0,078	0,065	0,046	0,037	0,068	0,056	0,045	0,055	0,05	0,04
Nickel, mg/kg d.s.	12,3	10,8	15,4	12,6	37,8	40,3	21,5	18,8	10,6	10,8
Zinc, mg/kg d.s.	78,9	85,4	84,5	69,6	134	93,2	68,5	75,2	52,1	55,1
Iron, mg/kg d.s.	2980	2765	3150	3420	3766	3700	2500	2204	2164	2100
Cooper, mg/kg d.s.	18,5	17,9	18,5	16,3	43,4	34,8	20,1	19,6	16,1	15,8
Cadmium, mg/kg d.s.	0,15	0,12	0,14	0,15	0,25	0,28	0,2	0,18	0,12	0,14

Table 2 Characterization of soil samples near the wastewater treatment plant of Focsani - September 2015 campaign

Quality Indicator	Sample									
	S'1/1	S'1/2	S'2/1	S'2/2	S'3/1	S'3/2	S'4/1	S'4/2		
pH	6,89	6,76	6,58	6,93	7,37	7,11	7,34	6,87		
wet, %	15,02	9,65	8,15	16,81	1,16	26,47	14,9	9,8		
C organic, %	0,85	0,69	0,19	0,32	0,24	0,22	0,15	0,27		
Total nitrogen, % d.s.	0,382	0.257	0,163	0,149	0,071	0,059	0,072	0,057		
Ammonium, mg/kg d.s.	48,95	35,53	38,97	38,54	61,35	53,68	59,36	47,07		
Chloride, mg/kg d.s.	45,9	35,3	27,05	38,27	43	43,4	16,6	19,7		
Sulfati, mg/kg d.s.	527,1	307,7	223,1	251,2	225,6	202,6	374,8	231,6		
Total phosphorus, % d.s.	0,23	0,11	0,11	0,108	0,052	0,058	0,057	0,054		
Nickel, mg/kg d.s.	24,18	17,14	33,8	34,1	28,4	27,9	21,9	25,7		
Zinc, mg/kg d.s.	106	81,3	49,14	47,6	111,9	98,5	30,88	36,9		
Iron, mg/kg d.s.	5612	5531	4870	4812	3620	3597	3918	3968		
Cooper, mg/kg d.s.	66	36,8	24,04	21,3	34,5	30,18	15,9	18,2		
Cadmium, mg/kg d.s.	0,5	0,06	<0,02	<0,02	0,15	0,09	<0,02	<0,02		

Table 3 Characterization of soil samples near the wastewater treatment plant of Slobozia - July 2015 campaign

Quality Indicator	Sample									
	P1/1	P1/2	P2/1	P2/2	P3/1	P3/2	P4/1	P4/2	M/1	M/2
pH	6,99	6,84	6,73	6,70	6,93	7,14	6,57	6,83	6,67	6,82
wet, %	12,25	10,26	13,93	12,33	12,47	13,01	33,06	33,08	12,8	14,1
C organic, %	0,08	0,06	0,46	0,39	0,07	0,06	0,78	1,1	0,05	0,04
Total nitrogen, % d.s.	0,283	0,259	0,405	0,340	0,215	0,194	0,871	0,782	0,186	0,220
Ammonium, mg/kg d.s.	21,02	19,04	20,14	18,69	21,17	19,18	26,71	25,26	15,42	16,16
Chloride, mg/kg d.s.	24,27	39,55	37,12	48,59	56,78	32,64	116,67	106,09	20,1	18,8
Sulfati, mg/kg d.s.	168,66	125,91	187,05	248,65	672,91	578,22	389,9	348,17	121,2	114,7

Total phosphorus, % d.s.	0,065	0,058	0,184	0,162	0,151	0,146	0,605	0,593	0,058	0,064
Nickel, mg/kg d.s.	30,1	26,4	46,8	37,1	61	39,6	19,8	18,8	18,6	16,1
Zinc, mg/kg d.s.	56,8	47,1	100,02	50,3	228,3	205,1	49,6	48,4	15,8	15,4
Iron, mg/kg d.s.	4256	3967	3744	3737	4065	3967	3352	3149	3068	2876
Cooper, mg/kg d.s.	71,1	62,7	47,5	42,4	41,6	38,4	36,5	20,5	18,6	16,1
Cadmium, mg/kg d.s.	1,16	0,71	0,68	0,19	0,25	0,18	0,19	0,22	0,15	0,12

Table 4 Characterization of soil samples near the wastewater treatment plant of Slobozia- September 2015 campaign

Quality Indicator	Sample									
	P'1/1	P'1/2	P'2/1	P'2/2	P'3/1	P'3/2	P'4/1	P'4/2		
pH	6,37	6,42	7,07	6,81	6,51	6,32	6,56	6,81		
wet, %	12,3	10,13	8,74	15,85	21,05	15,14	6,3	5,33		
C organic, %	0,5	0,22	0,47	0,42	0,88	0,66	0,46	0,36		
Total nitrogen, % d.s.	0,063	0,051	0,232	0,234	0,601	0,547	0,11	0,097		
Ammonium, mg/kg d.s.	31,8	25,89	22,14	22,52	25,06	20,89	22,71	21,24		
Chloride, mg/kg d.s.	36,68	31,6	35	84,37	89,93	83,88	76,27	74,99		
Sulfati, mg/kg d.s.	159,83	195,83	158,8	177,06	397,72	359,4	146,22	177,45		
Total phosphorus, % d.s.	0,066	0,059	0,091	0,082	0,408	0,292	0,064	0,054		
Nickel, mg/kg d.s.	29,42	27,71	40,8	28,45	64,3	40,1	36,5	37,5		
Zinc, mg/kg d.s.	62,08	51,7	125,7	91,8	215,6	192,4	67,1	74,5		
Iron, mg/kg d.s.	1953	1721	4311	4008	3426	3210	2315	2396		
Cooper, mg/kg d.s.	11,14	8,32	66,44	65,9	32,8	22,16	21,7	22,2		
Cadmium, mg/kg d.s.	0,07	<0,02	0,96	0,72	0,12	0,07	<0,02	<0,02		

Table 5. Characterization of water samples near the wastewater treatment plant of Focsani

Quality Indicator	July campaign 2015			September campaign 2015		
	Effluent discharge station	Putna river – upstream effluent discharge station	Putna river – downstream effluent discharge station	Effluent discharge station	Putna river – upstream effluent discharge station	Putna river – downstream effluent discharge station
pH	7,44	6,83	7,58	7,65	7,78	7,71
COD, mg O_2/l	81	38,4	40,1	96	39	48
BOD, mg O_2/l	25	12,7	11,1	25	11	14
Ammonium, mg/l	1,68	0,58	0,59	0,96	0,78	0,75
Total nitrogen, mg/l	6,21	3,78	4,01	9,12	4,02	5,8
Total phosphorus, mg/l	0,18	<0,02	0,08	0,51	0,06	0,14
Nitrates, mg/l	17,08	11,56	13,1	23,9	9,33	13,3
Nitrites, mg/l	0,8	0,5	0,6	0,69	0,21	0,29
Chloride, mg/l	273,35	184,6	207,67	244,9	262,7	255,6
Sulfides, mg/l	<0,04	<0,04	<0,04	<0,04	<0,04	<0,04
Residuu, mg/l	966	630	728	934	856	822
Zinc, mg/l	0,16	0,08	0,09	0,023	0,009	0,018
Nickel, mg/l	0,007	0,007	0,006	0,046	0,044	0,047
Cooper, mg/l	<0,003	<0,003	<0,003	0,006	0,006	0,005
Iron, mg/l	0,26	0,20	0,25	0,16	0,08	0,09
Cadmium, mg/l	0,002	0,002	0,002	<0,001	<0,001	<0,001

Table 6. Characterization of water samples near the wastewater treatment plant of Slobozia

Quality Indicator	July campaign 2015			September campaign 2015		
	Effluent discharge station	Ialomita river – upstream effluent discharge station	Ialomita river – downstream effluent discharge station	Effluent discharge station	Ialomita river – upstream effluent discharge station	Ialomita river – downstream effluent discharge station
pH	7,86	7,82	7,84	7,27	6,63	6,77
COD, mg O_2/l	67,2	40	48,8	<30	<30	<30
BOD, mg O_2/l	21,8	12	18,1	-	-	-
Ammonium, mg/l	1,19	0,97	1,03	0,696	0,71	0,696
Total nitrogen, mg/l	4,87	1,91	1,66	4,37	4,4	4,86
Total phosphorus, mg/l	0,97	0,097	0,13	0,98	0,187	0,173
Nitrates, mg/l	17,08	2,9	2,67	18,9	6,92	12,26
Nitrites, mg/l	0,11	0,05	0,11	0,13	0,17	0,16
Chloride, mg/l	266,2	237,8	222,7	253,8	216,5	213
Sulfides, mg/l	<0,04	<0,04	<0,04	<0,04	<0,04	<0,04
Residuu, mg/l	1252	732	730	1090	1028	1132
Zinc, mg/l	0,14	0,2	0,16	0,11	0,08	0,09
Nickel, mg/l	0,004	0,004	0,003	0,012	0,005	0,004
Cooper, mg/l	0,004	0,003	0,003	<0,003	<0,003	<0,003
Iron, mg/l	0,37	0,27	0,28	0,29	0,21	0,18
Cadmium, mg/l	0,003	0,004	0,003	0,009	<0,001	<0,001

Highlighting compliance with the laws in force in the quality of environmental factors investigated in the vicinity of wastewater treatment sites was pursued by comparing the analytical determinations of samples with values stipulated in the provisions specific to each environmental components.

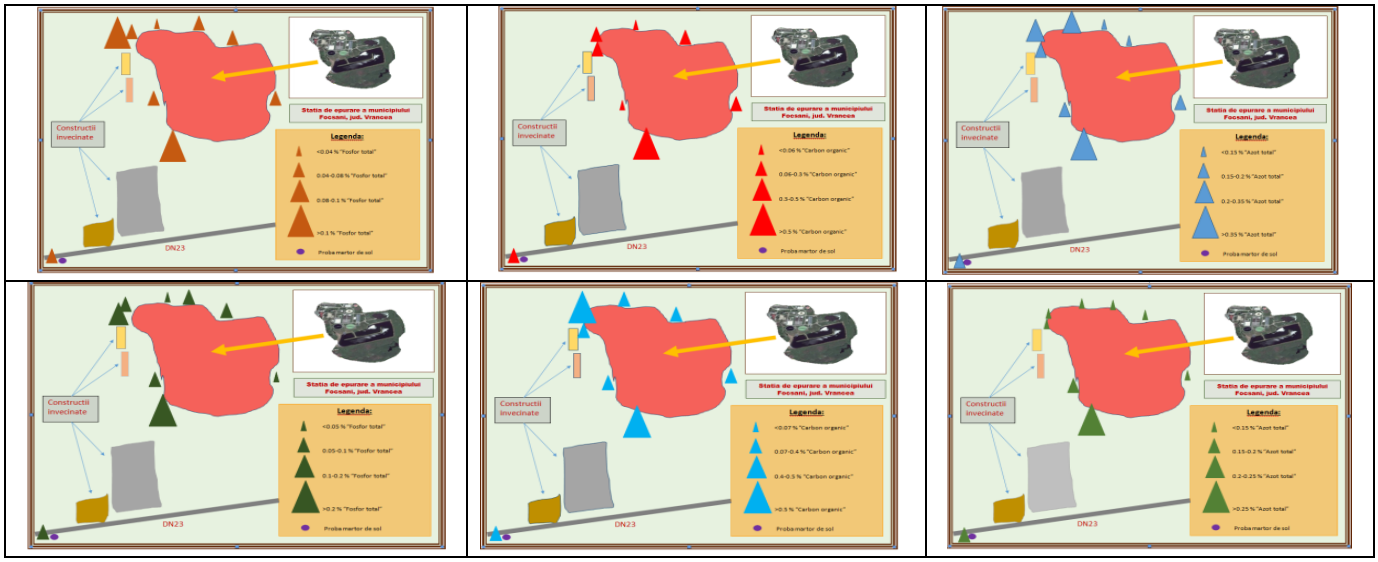
SOIL

Comparing the quality parameter values determined in soil samples was done both with the values stipulated in Ord.756 / 1997 (for the rules indicators) [5] and blank values (for all indicators). Were highlighted the following:

➢ **Wastewater treatment plant of Focsani**

- *pH* of soil samples indicates a neutral reaction soil near the station site
- the indicators: *C organic , total nitrogen, total phosphorus* had values that were above the values determined in the blank, but it not indicate pollution with these compounds
- considered heavy metals (*nickel, zinc and copper*), even if exceedings the proper normal values, were below the alert threshold values

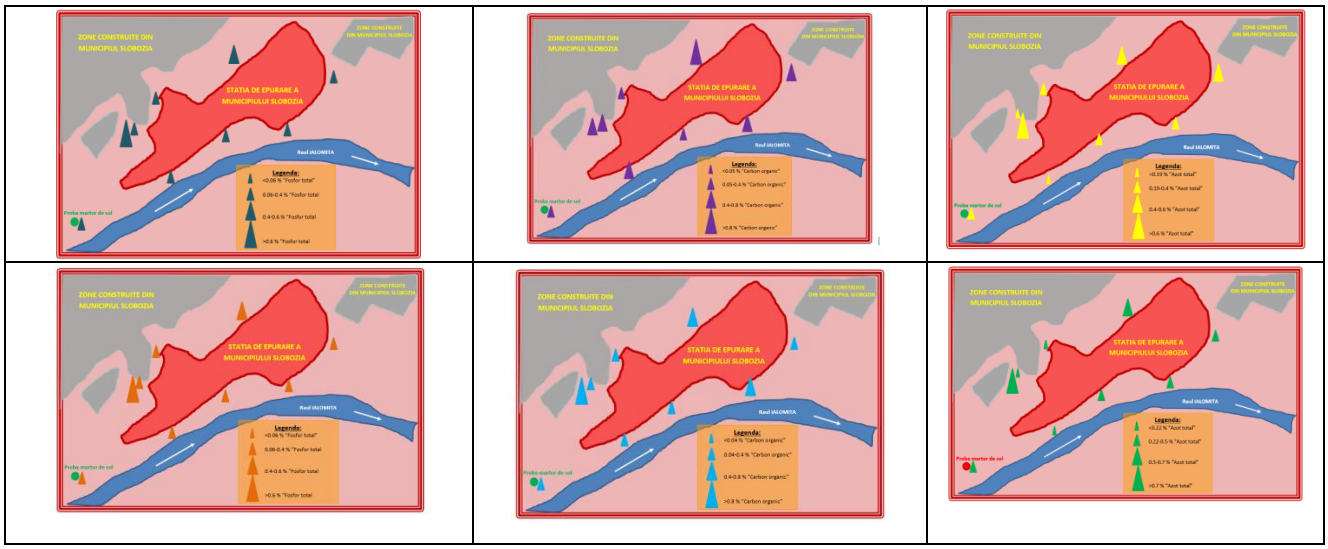
The diagrams representation of the state of pollution in the area neighboring the WWTP Focsani, are presented for indicators: total phosphorus, organic carbon, total nitrogen.



➢ **Wastewater treatment plant of Slobozia**

- *pH* values for samples recorded in both campaigns, indicated a weak acid-neutral reaction soil near the station
- the indicators: *C organic , total nitrogen, total phosphorus* had values that were above the values determined in the blank, but it they were located in areas of nonpolluted soils characteristic variation
- considered heavy metals (*nickel, zinc and copper*), even if exceedings the proper normal values, were below the alert threshold values

The diagrams representation of the state of pollution in the area neighboring the WWTP Focsani, are presented for indicators: total phosphorus, organic carbon, total nitrogen.



WATER

Values indicators analyzed in samples of treated effluent in both stations were located below the limits imposed by both environmental permits and by NTPA 001/2005 [6]. Therefore are discharged into emissaries natural receptors, from both WWTP,effluents with complying quality.

Analysis of the characteristics determined in samples of surface water in both campaigns investigation for both wastewater treatment plants have shown that, discharge of effluents station in natural emissaries (Putna river or Ialomita river) have not led to changes in the state of quality to emissaries in upstream to downstream.

4. Conclusions

Investigation of environmental quality components in proximity of municipal sewage treatment plants Focsani and Slobozia has allowed to quantify the impact induced by the activities carried out in the two stations near the sites.

The results of characterize components of environmental soil and water, interpreted in accordance with environmental legislation specific and illustrating the state of pollution in the areas surrounding sewage treatment plants by presenting diagrams led to the conclusion that activities carried out in the sites did not induce negative effects in proximity.

Acknowledgements

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