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ENVIRONMENTAL IMPACT OF WATER FROM WASTEWATER TREATMENT PLANTS

BY

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Abstract. The results of a study of the impact of wastewater within water treatment plants on the environment are presented. Therefore, the quality of wastewater is analysed from one of the Romanian municipalities. The water samples were collected in two campaigns at 2, 4, 8 or 12 hours interval. All samples were analysed to obtain main physical-chemical parameters and the obtained results are compared with the quality parameters provided in the Regulations for wastewater discharge in the sewers of urban areas. The maximum accepted values for various chemicals are exceeded in the study and contaminants are introduced into the environment that causes instability and disorder to the ecosystem. The impact of wastewater on air quality is also analysed and the sources of air pollution are identified: biochemical processes and vaporization from wastewater treatment plants. The nature and intensity of the sewage attack on the environment are mainly determined by the chemical agents resulted from the technological processes carried out, especially, within industry.

Key words: aggressive water; environmental quality; chemical characterization; pollution.

1. Introduction

Urban wastewater comes from mixing domestic-fecal sewage with industrial sewage. Domestic wastewater contains a wide range of polluting substances, such as: putrescible organic matter of animal or vegetal origin, which is fresh or in various states of biochemical decomposition, mineral salts, and microorganisms [1]. These waters also comprise hormones, vitamins, soaps, detergents, etc.

The substances comprised may take the form of solutions, colloidal suspensions or suspensions of solid particles of various sizes.

Along with the wastewater, a wide range of organic substances are drained: proteins, carbohydrates, fats, soaps, colouring agents, etc. These ones may either have a direct and instant effect or a delayed effect on contiguous materials due to their biochemical decomposition. The most common types of proteins incorporated are: albumins, gelatin, keratin, fibroin, casein, gluten. It may be noted that certain proteins also comprise sulfur and phosphorus in their molecule, besides carbon, nitrogen, oxygen and hydrogen. Once immersed in water and acted upon by bacteria, these substances are decomposed into simple elements: amino-acids, fatty and aromatic acids, various organic bases (aliphatic amines, putrescine, cadherin, indole-amine, indole, hydrogen sulfide, organic sulfides) and various compounds of phosphorus.

Besides proteins, a major part in organic pollution is played by fats, which are either insoluble in water or hardly soluble. Through bacterial action the fats are decomposed into glycerin and fatty acids, among which butyric and valeric acid. Hydrocarbons are quite common in wastewater, from simple types (monosaccharide or disaccharide), to the more complex types (polysaccharide, dextrin, glycogen, cellulose, starch). While monosaccharide and disaccharide elements are easily decomposed by the bacterial flora of wastewater, polysaccharides, due to their insoluble nature, float on the water mass or accumulate as deposits and therefore hardly dissolve. Besides the above mentioned organic substances wastewater also contains various nitrogen, phosphorus and potassium salts. Nitrogen and phosphorus salts are also created through the mineralization of organic substances acted upon by bacteria.

Because sewage coming from sulfate unbleached cellulose manufacture is collected in the wastewater treatment plant, these waters comprise various percentages of the following substances: lignin, resin acids and soaps, fatty acids, diterpene alcohol, phytosterols, juvabione, sugars, sulfur compounds (hydrogen sulfide, thiols, sodium sulfide), caustic soda. Following cellulose bleaching, the resulted effluents also comprise other chemical compounds: chlorinated lignin, chlorinated acids, chlorinated phenols, chlorinated aldehydes, chlorinated ketones, chlorinated aromatic and aliphatic hydrocarbons.

2. Quality and Origin of Used Water

The quality of wastewater flowing into the treatment plant was determined based on the samples collected on an 24 hours time period, in two collection campaigns.

The study consider the average samples collected at 2, 4, 8 or 12 hours intervals taking into account all quality parameters provided in the Regulations for wastewater discharge in the sewers of urban areas, namely NTPA *002*/2002: pH, suspended matter, organic substances dosed as CCO-Cr and CBO_5, ammonia nitrogen, nitrates, nitrites, total Kjeldahl nitrogen, phosphates, total phosphorus, sulfide, sulfite, sulfate, petroleum ether-derived substances, anion-active synthetic detergents, phenols, cyanide, free chlorine, chlorides, heavy metals (lead, cadmium, chromium, copper, nickel, zinc and manganese). It should note the fact that the symbol CBO_5 represents biochemical oxygen consumption which is determined by measuring the oxygen consumed by a sample throughout five days of activity of the microorganisms. This test provides data about the manner in which the respective effluents influence the oxygen balance of outfall sewers.

CCO-Cr represents the chemical oxygen consumption of a sample through direct chemical oxidation with potassium dichromate. The difference between CCO-Cr and CBO_5 determinations indicates the presence of persistent materials.

Wastewater from the municipality and industrial areas (41% domestic-fecal sewage, 39% industrial sewage and 20% conventional clean waters) flows into the treatment plant through five sewer mains, namely

a) *A* sewer gathers sewage from the central areas of the town and from the industrial areas;

b) *B* sewer gathers sewage from two companies; this wastewater has a high content of impurities (cellulose fiber, organic substances, hydrogen sulfide, foam-colouring agent);

c) *C* sewer collects sewage with low impurity content from neighboring industrial facilities;

d) *D* and *E* sewers are joined before entering the sewage treatment plant and collect wastewater from the bordering areas of the municipality and part of the wastewater from the industrial area.

Nearly 600…650 L/s of domestic-fecal sewage from the central area of the town as well as industrial sewage from the corresponding industrial facilities flow through *A* sewer main. The following industries are performed in this area: food industry (milk processing, manufacture of meat cans, brewery, bread making, etc.), textile industry (clothing industry, knitting) and inorganic chemistry industry (glass industry). The physical-chemical study of sewage flowing in *A* sewer during the two sampling campaigns, is showed in Tables 1 and 2.

Table 1

Physical-Chemical Features of Water within A Pipe

Quality parameter	Determined values
Suspended matters , [mg/L]	119.5
CBO_5, [mg /L]	76.0
Ammonia nitrogen, [mg/L]	1.8
Sulfides, [mg/L]	1.03
Anion-active detergents, [mg/L]	0.9

The physical-chemical features (maximal test values) of *A* inflow in accordance with technical provisions in force are shown in Table 1. The first feature noticed was the qualitative variability of raw wastewater which depends on a series of factors such as: the share of various types of wastewater in the effluent composition, the fluctuation of pre-treatment equipment efficiency according to the type of origin, disturbances of wastewater drainage due to technologies, qualitative variation of domestic-fecal sewage during daytime with overflow in the peak hours, etc. The majority of suspended matters have an organic nature, the average volatile content of the suspension being of 68.48% in the first sampling campaign and of 60.45% in the second one.

Heavy metals are present in *A* effluent in smaller amounts than the maximum allowable values laid down in the applicable regulations, as illustrated in Table 2.

Table 2
Heavy Metals Present in the Sewage from A Sewer Main

No.	Quality parameters	Average values determined for 12 hours, [mg/L]				Maximum allowable values
		1st sampling between hours		2nd sampling between hours		
		$19^{00}...6^{00}$	$7^{00}...18^{00}$	$19^{00}...6^{00}$	$7^{00}...18^{00}$	
1	Lead	0.0005	0.0005	0.0025	0.003	0.5
2	Cadmium	0.0005	0.0005	0.001	0	0.1
3	Total chromium	0	0	0.001	0.008	–
4	Trivalent chromium	0	0	0.001	0.008	1
5	Hexavalent chromium	0	0	0	0	0.1
6	Copper	0	0	0.001	0.001	0.1
7	Nickel	0.038	0.082	0	0	1.0
8	Zinc	0.013	0	0.038	0.019	1.0
9	Manganese	0	0.015	0.01	0.018	1.0
Overall		0.051	0.098	0.0545	0.057	1.0

It is also noticed that the additional heavy metal concentrations present in wastewater is smaller than the maximum allowable value stipulated in regulations (1 mg/L). Only the quality parameters of sulfides and hydrogen sulfide exceeded the value of the maximum allowable concentration (MAC). However, if during the first sampling campaign was observed frequent excesses (3 out of 12 measurements exceeded the standard concentrations), in the case of the second sampling campaign was recorded constant surpass of the three concentration levels (minimum, average, maximum), as it is shown in Table 3.

B sewer transports almost 120…200 L/s industrial pre-treated sewage from two companies, which are directly flown into the biological stage of treatment. The field of activity of the first company is the manufacture of bleached cellulose through the sulfate procedure and the manufacture of various types of paper and cardboard, using the wood of deciduous trees as raw material (beech, poplar, birch, etc.). The second company deals with furniture manufacture. The conditions of wastewater drainage laid down in the contracts of the two companies are shown in Table 4.

Table 3
Excess Values of A Sewer Pipe Compared to the Maximum Allowable Concentration (MAC)

Concentration level	Percentage of going over MAC value, %	
	1st sampling	2nd sampling
Lowest	–	120
Average	–	196
Highest	102	400

Table 4
Discharge Conditions of Wastewater from B Sewer

Flow L/s	Suspended matter mg/L	CBO_5 mg/L	H_2S mg/L	Phenols mg/L
300	200	300	0.5	20
300	200	300	0.5	20

The physical-chemical characterization of chemically pre-treated sewage flowing through *B* sewer which was determined during the two sampling campaigns is shown in Tables 5 and 6.

Table 5
Physical-Chemical Features of Water from B Sewer

Quality parameters	Average values	Maximum allowable values
Suspended matters, [mg/L]	220.62	300
CCO-Cr, [mg O_2/L]	775.91	500
CCO-Mn, [mg O_2/L]	–	–
CBO_5, [mg O_2/L]	253.95	300
Ammonia nitrogen, [mg NH_4/L]	10.35	30
Sulfides + H_2S, [mg S_2/L]	10.47	0.5
Anion-active detergent, [mg/L]	0.09	30

Table 6
Values over MAC for B sewer

Quality parameter	Percentage of going over MAC value		
	Lowest	Average	Highest
CCO-Cr	7	55.18	117.4
CBO_5	–	–	5.95
Suspended matters	–	–	15.83
Sulfides	1,160	1,994	2,987
Sulfites	306	451.9	552
Extractible substances	–	–	189

All pollutants present in *B* inflow originate mainly from the two companies. Therefore it may state that the qualitative and quantitative variability of the treatment plant inflow depends of the pre-treatment efficiency and on the continuous and constant discharge from polluting units.

Chemically pretreated sewage is opaque, its colour ranging from yellow to brown, with specific smell of cellulose sulfate and with high foaming capacity. The values of pH index were constantly within the limits recommended by MAC, in accordance with applicable requirements (pH = = 6.5...8.5). The suspended matter content varies according to the operation mode of the pretreatment plant and, of course, according to the degree of fiber recovery. The highest value registered was about 347.5 mg/L, being 2.5 times higher than the minimal value (134.5 mg/L) and 1.1 times higher than the concentration recommended by MAC values (300 mg/L).

Organic matter content which was dosed as CCO-Cr, constantly exceeded all three levels of concentration, during both sample collections namely

a) the lowest concentration is 1.1 times higher than the highest allowed concentration;

b) the average concentration is 1.5 times higher than the highest allowed concentration;

c) the highest concentration is 2.1 times higher than the maximum allowed concentration.

The organic matter content dosed as CBO_5 was exceeded only at the level of maximal concentration (the maximal value was 1.5 times higher than the maximum allowed concentration), during both samplings.

The values which exceeded MAC occurred in the following manner [2]:

a) systematically at all three concentration levels (lowest, average, highest) for quality parameters of sulfides and sulfites;

b) frequently in the case of quality parameter of petroleum ether-derived substances (4 out of 12 determinations were higher than standard concentrations);

c) randomly in the case of ammonia nitrogen's quality parameter (1 out of 9 measurements conducted exceeded standard values).

The relatively high content of sulfides in *B* effluent may be explained through the large amounts of spent lye drained by accident in the plant sewage. Sulfides are a significant parameter for the characterization of wastewater on account of its chemical and toxic aggressiveness. Chemical aggression is represented by the deterioration of pipe and equipment's internal areas, whereas toxicity acts upon the microorganisms present in active sludge. (De B e l i e *et al.*, 2004).

The heavy metals identified in *B* inflow had much lower concentrations than the ones allowed in technical regulations, the addition of their concentrations being below the maximum allowed 1 mg/l, as can be seen in Table 7.

Table 7

Heavy Metal Content in Treated Water of B Sewer

No	Quality parameter	Average values for 12 hours, [mg/L]				Maximum allowable values
		1st sampling between hours		2nd sampling between hours		
		$19^{00}…6^{00}$	$7^{00}…18^{00}$	$19^{00}…6^{00}$	$7^{00}…18^{00}$	
1	Lead	0.001	0.001	0.003	0.004	0.5
2	Cadmium	0	0	0.002	0.002	0.1
3	Total chromium	0.0005	0,0035	0.001	0.005	–
4	Trivalent chromium	0.0005	0.0035	0.001	0.005	1
5	Hexavalent chromium	0	0	0	0	0.1
6	Copper	0.0005	0.0025	0.002	0.002	0.1
7	Nickel	0.0985	0.13	0.024	0.004	1.0
8	Zinc	0.029	0.0695	0.032	0.082	1.0
9	Manganese	0.0165	0.0695	0.024	0.016	1.0
Overall		0.146	0.2315	0.088	0.115	1.0

Through *C* sewer main flow nearly 250…300 L/s of conventional clean waters (deemed to have low impurity content) from industrial facilities. The quality of wastewater determined in the two sampling campaigns is illustrated in Table 8. The study of these analytical data, in analogy with the values of maximum allowable concentrations, revealed the presence of the whole range of pollutants studied.

Table 8

Heavy Metal Content in Treated Water of C Sewer

No	Quality parameters	Average values for 12 hours, [mg/L])				Maximum allowable values
		1st sampling between hours		2nd sampling between hours		
		$19^{00}…6^{00}$	$7^{00}…18^{00}$	$19^{00}…6^{00}$	$7^{00}…18^{00}$	
1	Lead	0.0015	0.001	0.003	0.002	0.5
2	Cadmium	0.0005	0.0005	0.002	0.002	0.1
3	Total chromium	0.003	0.0005	0.0011	0.013	–
4	Trivalent chromium	0.003	0.0005	0.0011	0.013	1
5	Hexavalent chromium	0	0	0	0	0.1
6	Copper	0	0.0005	0.001	0.011	0.1
7	Nickel	0.1085	0.107	0	0.005	1.0
8	Zinc	0.02	0.056	0.04	0.08	1.0
9	Manganese	0.0035	0.0035	0.016	0.004	1.0
Overall		0,137	0.169	0.073	0.117	1.0

The following quality parameters were compared to MAC values: pH, organic substances (CCO-Cr, CBO_5), suspended matters, total phosphorus, sulfites, sulfates, anion-active synthetic detergents, phenols, cyanide, free chlorine and chlorides. It is noticed the much lower concentration of heavy metals compared to MAC values, the addition of their concentrations being lower than the maximum allowed, 1 mg/L.

The MAC values are almost systematically exceeded at the level of average and maximal concentration of sulfides' quality parameter; MAC values are randomly exceeded in the case of the following parameters:

a) ammonia nitrogen (1 out of 6 measurements conducted during the second sampling activity);

b) petroleum ether-derived substances (1 out of 6 measurements conducted during the second sampling activity).

The values exceeding MAC as far as concentration is concerned during the periods of investigation are showed in Table 9.

Table 9
Values of MAC for C Sewer

Quality parameters	Determined concentration	Percentage of going over MAC value	
		1st sampling	2nd sampling
Sulfides	average highest	44 278	776 880
Ammonia nitrogen	highest	–	8.2
Petroleum ether-derived substances	highest	–	41.5

The suspended matter content is variable, depending on the composition and origin of sewage transported. Furthermore, during the first sampling activity the suspended matters had mainly an organic nature (61% volatile content) while during the second sampling activity, suspended matters had mainly a mineral nature (37% volatile content). *D* + *E* sewer mains have an approximate flow of 250…300 L/s domestic-fecal sewage and industrial sewage from the economic facilities located in the area. The following industries are present: food industry (slaughterhouse, production of fruit soft drinks), light industry (shoe manufacture) and textile industry (fabric dyeing) and metallurgical industry (manufacture of machine-tool, impregnation of railway sleepers). The physical-chemical characterization of pretreated wastewater transported through *D* + *E* sewer mains, determined during the two sewage sampling activities, is showed in Tables 10 and 11.

Table 10
Values of MAC for D and E Sewers

Quality parameters	Yearly concentration	Percentage of going over MAC value	
		1st sampling	2nd sampling
Ammonia nitrogen	highest	–	32.26
Sulfides	average highest	40 594	– –

Table 11
Heavy Metal Content in Treated Water of D + E Sewers

No	Quality parameters	Average values for 12 hours, [mg/L]				Average values for 12 hours mg/L
		1st sampling between hours		1st sampling between hours		
		19…6	7…18	19…6	7…18	
1	Lead	0.0015	0.001	0.002	0.002	0.5
2	Cadmium	0.0005	0	0.002	0.002	0.1
3	Total chromium	0	0	0.006	0.001	–
4	Trivalent chromium	0	0	0.006	0.001	1
5	Hexavalent chromium	0	0	0	0	0.1
6	Copper	0	0.013	0.002	0.003	0,1
7	Nickel	0.107	0.023	0	0	1.0
8	Zinc	0.015	0.016	0.024	0.015	1.0
9	Manganese	0	0.0045	0.002	0.003	1.0
Overall		0.124	0.0575	0.038	0.026	1.0

After the study of the quality parameters must be noticed that most of them are comprised within MAC values: pH, organic substances (CCO-Cr, CBO_5), suspended matters, total phosphorus, sulfites, sulfates, petroleum-derived substances, anion-active synthetic detergents, phenols, cyanides, free chlorine and chlorides.

Randomly, was noticed that MAC values are exceeded in the case of the following parameters:

a) ammonia nitrogen (1 out of 9 determinations conducted);

b) sulfides (3 out of 18 determinations conducted).

The heavy metal concentrations are much lower than MAC values, their addition being less than 1 mg/L – the maximum allowable concentration. Suspended matters content is fluctuant and have mainly an organic nature (average volatile content of 56.06% in the first sampling and 72.17% in the second sampling activity).

3. Impact on Air Quality

Within the studied objective, the possible sources of air pollution are represented by

a) sewage treatment activity;

b) heating installation of the wastewater treatment plant;

c) cellulose and paper manufacturing plant, located in the surrounding area.

The potential sources of foul-smelling wastewater are the following:

a) fresh, septic or partially treated wastewater;

b) fresh or partially stabilized sludge;

c) oils, fats and soaps from economic agents, residences and street drains, retained in grease-removal tanks;

d) gas emissions from treatment technological processes, inspection chambers, pump stations, flowing containers, outlet areas.

Gas emissions of domestic sewers may be caused by

a) biochemical processes;

b) chemical reactions;

c) vaporization.

The mechanisms of gas production and transportation involves the constituent's conversion to the gaseous phase (or vapour phase), by vaporization, biological breakdown or chemical reactions. The transfer mechanism includes the transportation of a constituent in vapour state to the surface of the land or of the tank through the boundary layer of air above the plant and in the atmosphere. The three main mechanisms providing the transportation of a constituent are the following: diffusion, convection and adequacy. From collected and treated domestic and industrial sewage derive discharges of volatile organic compounds (VOC) in the air. Discharges may appear through diffusion or convection mechanisms. Diffusion occurs when VOC concentration at water surface is much higher than in air. Organic compounds evaporate or are diffused in air, trying to reach a balance between the liquid and the gaseous state.

Convection occurs when at the surface of wastewater there is a draft of air, which absorbs the vapours of organic compounds. It is thought that collected sewage comprises 0.9…5.6 mg/dm^3 of ammonia nitrogen. Starting from these values it may to notice that ammonia discharge (maximal) is of 5.734 g/s and that of volatile organic compounds is of 0.720 g/s. The heating installation of the treatment plant uses both biogas and light fuel oil. Combustion gases are released naturally through a flue which has 22 m height, square top section, and equivalent diameter of 2.0 m.

The plant was designed to operate mainly on biogas and in special cases (when the amount produced is inefficient) fuel oil is used. In reality, it is used more fuel oil as the biogas amount is not enough. Moreover, gas production cannot be controlled as the gasometer was taken out of service. In this context, the beneficiary could not provide accurate data regarding biogas consumption and only stated that nearly 120 kg /h of fuel oil are consumed throughout the operational period (9 months/year, operating 15 h/day). The calculations were made for the following pollutants: sulfur oxides (SO_2), nitrogen oxides (NO_2), carbon monoxide (CO) and suspended powders, in the context in which exclusively fuel oil is used, acknowledging a 2% sulfur content.

In the preliminary assessment of exhaust pollutant concentrations, the maximum allowed limits were exceeded for SO_2 (3,485.1 mg/N.m^3, compared to 1,700 mg/N.m^3, which is the maximum allowed value). The concentrations of other pollutants are much lower than the allowed ones.

It should point out the fact that certain installations built within the sewage treatment plant, such as the main radial flow settling pump, are located in the surrounding area of the cellulose and paper manufacture plant. This is a major source of air pollution with gas and vapours of sulfur dioxide, sulfur trioxide, sulfide hydrogen, hydrogen chloride-carrier combustion gases (H u a n g *et al*., 2005), sodium sulfate, sodium carbonate, phenols, ketones and chlori-nated acids, which are extremely aggressive to concrete and steel.

4. Conclusions

Wastewater comprises liquid waste discharged by domestic residences, commercial properties, industry, and/or agriculture and can encompass a wide range of potential contaminants and concentrations. Usually, the municipal wastewater contains a broad spectrum of contaminants resulting from the mixing of wastewaters from different sources.

The nature and intensity of the sewage attack on constructions and on the environment are mainly determined by the chemical agents resulted from the technological processes carried out, as well as by other aggressive factors caused by technological equipment and installations which are located in the surrounding area of the studied facility [3].

In real condition of operating technological installations and networks, usually the maximum concentrations of corrosive substances are exceeded. Thus, the pollution intensity is hard to forecast and managed, especially when the aggressive actions go much beyond the initially set parameters [4].

The sewage is not just a locally problem in Romania. The U.S. Environmental Protection Agency estimates that every year, in each county across the U.S. nation, the amount of untreated or partially treated sewage that enters the environment is enough to fill both the Empire State Building and Madison Square Garden. According with a report made in 2004, the sewage overflows in United States of America are creating an environmental and public health crisis [5].

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R E F E R E N C E S

1. Mara D.D., Sleigh P.A., Blumenthal U.J., Carr R.M., *Health Risks in Wastewater Irrigation: Comparing Estimates from Quantitative Microbial Risk Analyses and Epidemiological Studies*. J. of Water and Health, **5**, *1*, 39-50 (2007).
2. Singh K.P., Mohan D., Sinha S., Dalwani R., *Impact Assessment of Treated/Untrea-ted Wastewater Toxicants Discharged by Sewage Treatment Plants on Health, Agricultural, and Environmental Quality in the Wastewater Disposal Area*. Chemosphere, **55**, *2*, 227-255 (2004).

3. Taebi A., Droste R.L., *Pollution Loads in Urban Runoff and Sanitary Wastewater.* Sci. of the Total Environ., **327**, *1-3*, 175-184 (2004).
4. Gilbert R.O., *Statistical Methods for Environmental Pollution Monitoring*. John Wiley and Sons, NY, 1987.
5. Dorfman M. *et al.*, *Swimming in Sewage. The Growing Problem of Sewage Pollution and how the Bush Administration is Putting our Health and Environment at Risk*. Environ. Integrity Project a. Natural Res. Defense Council, February 2004, http://www.nrdc.org/water/pollution/sewage/sewage.pdf.

IMPACTUL ASUPRA MEDIULUI AMBIANT AL APELOR UZATE DINTR-O STAȚIE DE EPURARE

(Rezumat)

Se prezintă rezultatele unui studiu al impactului apelor uzate din cadrul unei stații de epurare asupra mediului înconjurător. În acest sens, este analizată calitatea apelor uzate ale unuia dintre principalele municipii ale României. Probele au fost recoltate la un interval de 2, 4, 8 şi 12 ore în două etape de colectare. Toate probele au fost analizate în vederea obținerii principalelor caracteristici fizico-chimice ale apei, rezultatele fiind comparate cu valorile maxime admise conform normelor în vigoare. S-a constatat depăşirea valorilor maxime admise pentru mai mulți agenți chimici, reintroducerea acestora în circuitul natural conducând la o poluare accelerată a mediului şi la dezechilibre în ecosistem. De asemenea studiul prezintă şi influența apelor uzate asupra calității aerului din imediata vecinătate, fiind identificate principalele cauze ale poluării acestuia : procesele biochimice şi vaporizarea. Intensitatea poluării mediului datorată apelor uzate este în principal determinată de agenți chimici rezultați din procesele tehnologice efectuate, în special, în cadrul industriei.