Summary of professional accomplishments

1. Name and Surname: **MałgorzataWolska**

2.Diplomas and Degrees obtained:

a) 2000 - Master of Science in Environmental Engineering, Wroclaw University of Technology,Department of Environmental Engineering, field of study: Environmental Engineering,specialization in Water and Wastewater Technology;

b) 2004 - Doctor of Technical Sciences in Environmental Engineering, Wroclaw University of Technology, Faculty of Environmental Engineering. Title of doctoral dissertation: "The changes in selected parameters of water quality in the water distribution system"

3. Information on previous employment in research institutions

a) 2004 - 2007 – Academic Assistant, Wroclaw University of Technology, Department of Environmental Engineering, Institute of Environmental Engineering;

b) 2007 - 2014 – Assistant Professor, Wroclaw University of Technology, Department of Environmental Engineering, Institute of Environmental Engineering.

c) 2014 - 2015 – Assistant Professor, Wroclaw University of Technology, Department of Environmental Engineering, The Chair of Water and Waste Treatment Technology

4. Indication of achievements * under Art. 16 paragraph. 2 of the Act of 14 March 2003 on Academic Degrees and Academic Titles, as well as Degrees and Titles in the Field of Art (Dz. U. [Journal of Laws] No. 65, item. 595, as amended):

"Removal of biogenic substances in the treatment technology of water intended for human consumption" – Habilitation monograph

A) (author / authors, title / titles of publication, year of publication, name of publisher)

Wolska M. Removal of biogenic substances in the treatment technology of water intended for human consumption. Publisher: Technical University of Wroclaw, Wroclaw 2015.

B) A discussion of the scientific / artistic goals of the aforementioned work / works and the results achieved, along with a discussion of their possible exploitation.

A. Source of the problem

The deterioration of water quality on its way from the treatment plant to the customer which has been observed in many water distribution systems worldwide [7, 14, 18, 19, 21, 50, 61, 66, 78, 81] is caused by the introduction of biologically and chemically unstable water into the water supply system. This lack of chemical stability of water leads to the corrosion of water pipes, or the formation of deposits on their internal surfaces, and is most often due to the absence of an optimized alkalization process at the water treatment plant.

In contrast, biological instability leads to the process of biological corrosion [3, 60] and the formation of biofilms inside water pipes [20, 33-35, 37, 45, 48]. Secondary growth of microorganisms in the water supply system is a potential source of microorganisms, including pathogens, in water consumed by the public. Presence of such pathogens was also noted in distribution systems [15, 23, 34]. Due to the higher risk to human health associated with the presence of heterotrophic microorganisms in water, limiting their development is a prerequisite to minimizing the problem of secondary water pollution, and particularly its biological contamination. This inhibition of the development of biofilms in the water supply system can be achieved by reducing the concentration of the nutrient substrates necessary for the growth of microorganisms [10, 24, 42, 79] and by ensuring the presence of a disinfectant in the entire distribution system [83, 94, 96]. An increase of heterotrophic microorganisms, besides nitrogen and phosphorus, is dependent on the presence of biodegradable dissolved organic carbon (BDOC) [12, 17, 32, 43, 52, 94], which should constitute 1-9% of the dissolved organic carbon (DOC) concentration [22]. Therefore, the inhibition of the secondary development of microorganisms can be obtained by ensuring a reduction of nutrients in the water entering the distribution system to very small concentrations.

Previous studies on the efficiency of the treatment of water intended for human consumption have focused on the possibility of removal of organic substances [26, 40, 47], and in particular on the precursors of disinfection by-products [9, 11, 51, 58]. Von Guten [80] demonstrated that a high efficiency of removal of the precursors of chlorinated organic substances was presented by the coagulation process. Also, the adsorption process- especially when preceded by ozonation- allows for a very effective elimination of dissolved organic carbon [30, 82, 89, 93]. Unfortunately, little attention is paid to the removal of the biodegradable fraction of organic matter from water during treatment- especially of water intended for human consumption. The efficiency of eliminating BDOC concentrations in the conventional water treatment system is low [69, 84], and total organic carbon concentration is about 22.0% [26]. Several studies [6, 23, 28, 31, 53, 56, 57, 87] have demonstrated that the chemical oxidation process leads to a very large increase in the concentration of BDOC. Biodegradable materials arise from the transformation of multimolecular organic substances into smaller ones. Therefore, after this process (currently ozone is used most widely as an oxidizing agent) it is imperative to include processesin the processing system which ensure the biodegradation of the resulting compounds [86].

Due to the small direct threat to human health posed by inorganic nitrogen compounds present in water, there is a lack of information regarding the suitability of individual water purification processes in their elimination. Reduction of the concentration of nitrogen compounds is afforded only by biological processes [1, 27, 39, 44, 46], which in water purification technology are rarely used.

Thus, the lack of data on the possibility of the removal of biogenic substances from water intended for human consumption and the need to reduce the risks of secondary pollution in local water provided the impetus for the undertaking of this problem.

B. Scientific Objectives of the Paper

The aim of the study was:

- To determine the suitability of individual water treatment processes and processing systems in removing biogenic substances.
- To define the factors influencing both the efficiency of individual processes and the course of the process of elimination of biogenic substances from water during purification.
- To enrich knowledge on the possibility of elimination of biodegradable dissolved organic carbon in water purification technology of water intended for human consumption.
- To provide information on the capabilities and efficiency of the elimination of inorganic nutrient substrates in individual water treatment processes as well as in processing systems.
- To determine the impact of the type of water to be treated and the level of contamination on the efficiency of the removal of nutrients.
- To define the factors inhibiting the growth of microorganisms in secondary distribution systems.

C. Results Obtained

The study focused on: surface water, infiltrated water and mixed (groundwater after aeration with surface water post-microfiltration) in technical conditions. Thanks to this it was possible to assess the suitability of individual processes in the removal of nutrients in the water purification plants exploited, and to determine the degree of nutrient substrate elimination in overall processing systems.

The study showed that among conventional water treatment processes only coagulation allows for a significant reduction of biogenic substances [84, 92]. The efficiency of the contact coagulation process carried out via iron sulfate was higher than that obtained in volume coagulation via polyaluminum chloride (PAC) [90]. This process is shown by many authors to be very effective in the elimination of precursors of chlorinated organic substances and of little help in removing BDOC [40]. In this study, regardless of the manner of conducting coagulation, a considerable increase in the efficiency of the elimination of organic nutrient substrates was obtained, due to the adsorption of these compounds on the surfaces of solid particles present in the water undergoing treatment.

This intensive adsorption rate was possible due to the prolonged sedimentation time, resulting from an operating facility with smaller than nominal efficiencies. This process afforded a very effective removal of phosphates (on average 63.5%), which was greater than that obtained in studies by Bektas, et al [2]. This was most likely related to the use of much higher doses of coagulants - especially iron sulphate, which is used in contact coagulation. Unfortunately, among inorganic nitrogen compounds, only ammonium ions were successfully removed in the coagulation process, and these accounted for only 0.8% to 51.8% of the total inorganic nitrogen content. Elimination of these ions occurred through adsorption on the surface of solid particles and / or biological assimilation by microorganisms [70]. The elimination of nitrates in the contact and volume coagulation process in the analyzed water purification systems was not large, and resulted from the long retention time of water in sedimentation tanks/accelerators – that is, conditions conducive to the growth of microorganisms, and thus the possibility of assimilation of these ions.

Other conventional water treatment processes (aeration, rapid sand filtration and disinfection) had no influence on the content of biogenic substances. There was no increase in the concentration of the biodegradable fraction of organic substances during the disinfection process in any of the processing systems. The lack of transformation of multimolecular substances to smaller molecular substances should be explained by the course of such a transformation during the intermediate oxidation process. The degree of transformation of multimolecular organic substances into smaller ones during oxidation depends on the amount of these substances in the water subjected to the process, and on the properties of these substances, e.g. their level of aromaticity.

Among the processes incorporated into processing systems with the aim of assisting to eliminate biogenic substances, especially organic substances, filtration through activated granular carbon beds (GAC) proved to be most effective. Regardless of the type of water, this process ensured the effective elimination of dissolved organic carbon as well as its biodegradable fraction (on average by 59.9% and 52.3%), which was associated with the biological activity of the microorganisms inhabiting the bed [89]. The elimination of all fractions of organic matter results from the simultaneous progress of biodegradation and adsorption. The resulting higher efficiency of BDOC removal and lower efficiency of DOC removal as compared to other studies [41] can be explained by the partial depletion of the capacity of the filter beds. Filtration through a bed of biologically active GAC turned out to be the only process which ensured the effective elimination of inorganic nutrient substrates. For both surface water and infiltration water, a large simultaneous reduction in the concentrations of ammonium and nitrate ions was observed, which indicates an absence of the nitrification process in filtration beds, despite their high dissolved oxygen concentration and the slow flow of water through the beds.

This process was least efficient for phosphate ions, due to their low content in the water subjected to the process. It is precisely this inadequate concentration of phosphate ions in the water flowing to the adsorption beds which could have been the cause of the limited activity of microorganisms inhabiting the filtration beds [32]. It could also have been the cause of the limited growth of autotrophic bacteria, which seems to be indicated by the absence of a nitrification process in these beds.

Unfortunately, the intermediate oxidation process, often incorporated into processing systems, does not affect the content of inorganic nutrient substrates and causes a very large increase in the volume of biodegradable dissolved organic, caused significantly more effective transformation of the multimolecular organic material to shorter carbon chain forms than intermediate oxidation via a mixture of chlorine and chlorine dioxide [87]. Therefore, it seems necessary to employ biological processes ensuring the efficiency of elimination of the BDOC formed after intermediate oxidation. This is a condition which must be met in order to limit the concentration of this nutrient substrate in water which is being introduced into the distribution system. The absence of processes which ensure the biodegradation of BDOC can make limiting the secondary development of micro-organisms in the water supply system impossible. This is confirmed by the greater efficiency of removal of BDOC in surface water treatment systems and infiltration water treatment systems (in these systems filtration through biologically active GAC beds was implemented) than during the treatment of mixed water.

Among the processes aiding in the purification of water, a reduction in the content of biogenic substances- especially BDOC and phosphate ions- was obtained through the process of microfiltration – in which poorly soluble phosphate ions were retained on the surface of the filtration material. Likewise, biodegradable organic substances could only be removed through their adsorption on the surface of larger molecules retained on the filtration material. An analogous removal mechanism was determined for ammonium ions, for which the average elimination efficiency rate amounted to 30,8%. Microfiltration, as the preliminary stage of water purification, thus allows for the limitation of nutrient substrates, however it is not sufficient to decrease the threat associated with regrowth of microorganisms.

Laboratory studies have shown instead the great utility of the MIEX® resin ion exchange process in the removal of both organic and inorganic anionic nutrient substrates. The resultant BDOC removal efficiencies were a great deal larger than those found in the remainder of the individual processes analyzed in technical conditions. The concentration of the fraction of organic substances after ion exchange in all water samples was much lower than the limit in terms of microorganism growth.

Ion exchange was the only process studied which ensured highly effective removal of nitrates. The average removal efficiency rate was 82,1% (given a dose of 20ml/dm^3 and with a 30 min resin exposure time). At the same time, phosphate ions were successfully removed. Their concentration in the purified water was very low and thus ensured the inhibition of secondary growth of microorganisms.

The studies, conducted on model solutions and natural water, demonstrated that the susceptibility of biodegradable substances to the ion exchange process decreases along with the increase in the content of both: multimolecular organic substances determining the UV absorbance value, and non-biodegradable dissolved organic carbon.

Also, the photolysis process allowed for a decrease in BDOC through the mineralization of organic substances. The efficiency of mineralization, however, was low – thus the utilization of this process is justified in a situation where there is a need to further purify water prior to chemical disinfection, which increasingly often takes place in technical conditions [13, 25, 47].

In each of the analyzed processing systems, the processes applied permitted a very efficient reduction in the content of phosphate ions and biodegradable dissolved organic carbon. In contrast, the efficiency of the elimination of inorganic nitrogen was low. The efficiency of removal of biogenic substances from mixed water was significantly lower than that determined for surface and infiltration water [86]. Among inorganic nitrogen compounds, only ammonium ions were effectively eliminated, and their average share in inorganic nitrogen in raw water amounted to 14,5%, 9,2% and 23,9%, respectively, for mixed, surface and infiltration water. Unfortunately, despite the presence in surface and infiltration water treatment systems of a BAC filtration process, the efficiency of removal of nitrates from these waters was low, and inadequate for the restriction of secondary growth of microorganisms.
Unfortunately, regardless of the source of the water and the type and sequence of the purification processes in processing systems, sufficient simultaneous elimination of biogenic substances was not obtained in any of the analyzed plants.

As a consequence of the insufficient removal of biogenic substances, biologically unstable water was introduced into the water distribution systems. In all of the analyzed plants, biological instability was determined by the concentration of inorganic nitrogen. The share of biologically stable samples in terms of their phosphate content amounted to 100%, 95,8% and 95,5%, respectively, for surface, infiltration and mixed water. The concentration of biodegradable dissolved organic carbon in most of the surface and infiltration water samples was also a factor which inhibited secondary growth of microorganisms. The absence of biological processes in the water purification system for mixed water should be explained by its significantly higher concentration of organic nutrient substrate, as compared to the other two systems.

The study demonstrated that the decisive factor for the efficiency of elimination of biogenic substances of individual processes as well as overall processing systems was their content in the water prior to undergoing each specific process. On the other hand, no significant statistical correlation between the efficiency of removal of biogenic substances and the parameters of the individual processes conducted was determined. The absence of such a relationship results from the exploitation of plants with yields which are much smaller than nominal yields, and thus contrary to the optimal parameters for their implementation.

However, with regards to the processes realized in laboratory conditions such a relationship was found. The efficiency of elimination of anionic nutrient substrates from water through the MIEX® resin ion exchange process was affected by both the dose of resin as well as the time of contact. The kinetics of the ion exchange process indicated the dominant role of adsorption over ion exchange, which can be described in accordance with Freundlich's isotherm . As a consequence of this, the greatest increase in the efficiency of the process was noted in the first 30 minutes of contact between water and resin, and at an increase in dose up to 20 ml/dm^3.

Also in photolysis the greatest efficiency of elimination of organic substances, including the biodegradable fraction, was determined in the first 30 minutes of exposure. The use of photolysis as the initial step in disinfection is recommended due to the possibility of reducing the content of organic substances, including TOX precursors, and eliminating substances susceptible to transformation into BDOC, which can take place during chemical disinfection.

D. *Conclusions/possibility of utilization of the results*

The studies conducted demonstrated:

- Among conventional water treatment methods, the greatest utility in removal of biogenic substances is demonstrated by coagulation, regardless of the manner in which it is conducted
- None of the conventional individual processes ensures simultaneous and sufficient efficiency in removal of biogenic substances
- The process of microfiltration can be used for preliminary water purification, as it assures a significant curtailment of biogenic substances – mainly phosphates, ammonia nitrogen and BDOC
- Filtration through active biological beds of granulated organic carbon displays the highest efficiency of removal of nutrient substrates of all the processes analyzed on a technical scale. The high utility of this process results from the simultaneous progress of physical, chemical and biological processes in the deposits.
- Regardless of the location of the application of the chemical oxidation process in processing systems, its utility in eliminating biogenic substances is dependent on the type and amount of total organic carbon in the water undergoing the process. This determines the degree of transformation of multimolecular organic substances into smaller ones, causing an increase in the concentration of BDOC, whose elimination is ensured by biological processes.
- None of the processing systems ensured a sufficient degree of elimination of inorganic nitrogen compounds, despite the presence of biological processes. Reducing the risk of

secondary growth of microorganisms is assured by a lower concentration of phosphates and biodegradable dissolved organic carbon than the limit levels in terms of biological stability.

- The efficiency of individual processes and processing systems is determined primarily by the level of contamination of the water undergoing purification.
- The MIEX® resin ion exchange process allows for the attainment of anionic biogenic substance concentrations significantly lower than limit levels in terms of biological stability of water, and thus provides for inhibition of secondary growth of microorganisms in the water distribution network. However , these results require verification on a pilot and/or technical scale.
- Photolysis allows only for a reduction in organic substances, among which biodegradable substances demonstrate a lower susceptibility to degradation than compounds which absorb UV radiation.
- The susceptibility of individual processes in removal of biodegradable substances is in accordance with the following sequence: MIEX® > Photolysis > Filtration through active biological beds of GAC > Coagulation > Microfiltration > Rapid sand filtration. The intermediate oxidation process, however, contributed to a significant increase in the content of this nutrient substrate.
- The orders of efficiency of removal of inorganic nitrogen and phosphates run:
    - MIEX® ion exchange > filtration through active biological beds with GAC > Coagulation > Microfiltration > Rapid sand filtration > Aeration (inorganic nitrogen)
    - MIEX® ion exchange > filtration through active biological beds with GAC > Rapid sand filtration >Aeration (phosphates)

3. A discussion the remaining scientific research achievements (artistic)

After obtaining a doctoral degree (2004 – 2014) scientific activities were related to:

a.) The level of secondary water pollution in distribution systems: its causes, course, as well as changes in the content of disinfectants in the distribution network [65-68, 73,74].

b.) Assessment of the change in biological stability of water in individual water purification processes as well as processing systems [69, 70, 84-86, 89, 92].

c.) Assessment of the impact of filtration (infiltration) materials on the change in chemical composition and microorganism biodiversity of water [4,5].

d.) Changes in the content of organic substances in individual water purification processes [16,62,64,72,75,88,87,90,91].

Works of an applicable character primarily concerned:

a.) The operation of the "process water" distribution system – expert assessment conducted for the Wastewater Treatment Plant. The study concerned the process water system utilized for the needs of all sites located on the property of the Wastewater Treatment Plant, including the highly water-intensive sludge dryer. Its result was: an assessment of the level of aggressiveness of process water, an appraisal of the need for process water and a conception for the optimization of this system.

b.) An assessment of the suitability of water from siphon intake, Wisłok and Dąbrówki being the sources of water in the Water Treatment Plant in WolaMała near Łańcut. As a result of the studies conducted, the degree of contamination of this water was determined in the following processing system: aeration-sedimentation-rapid sand filtration (I stage of Filtration) – aeration – sedimentation – filtration through beds developed to remove manganese (II stage of Filtration). The studies demonstrated the very high efficiency of the aeration process, as a result of which water becomes oxygenated, iron II undergoes oxidation into Fe(III) and aggressive carbon dioxide was eliminated. Unfortunately, the entire processing system did not ensure sufficient efficiency of removal of hue, turbidity and manganese. Only inclusion of an alkalization process ensured a sufficient improvement in the efficiency of water purification.

c.) An assessment of the causes of corrosion in a water supply network. The study was conducted on the internal water supply system of a retail facility. The study determined the magnitude of change in the composition of water in the internal network, and demarcated the segments in which the greatest deterioration in the quality of water was found. The results of the study were utilized to limit the progress of corrosion in the system.

d.) The selection of filtration materials constituting the filling of the drainage filters in at the place of intake of infiltration water. The study was conducted within the framework of a research and development project. The study determined the composition of infiltration water in contact with various materials, including: sand, Wojcieszów limestone, "Hydrocleanit", magnesite, braunsztyn. This allowed for a determination of the optimal granulation and composition of the gravel pack used in infiltration drains in the areas of water intake arising as a result of the realization of the project. Thanks to the realization of this project, the intake of water with a lower level of aggressivity will be possible.

e.) The secondary contamination of water in the distribution system. The study was conducted in collaboration with a water supply company on an extensive water distribution system area. It allowed for not only the determination of the magnitude and types of changes in the composition of water, but also for a designation of the areas of the greatest variations in water composition, and of those factors which helped determine these adverse changes.

The results of the studies conducted have been published in 29 publication (including 16 from the following list : JCR: Desalination and Water treatment, Environmental Protection Engineering, Polish Journal of Environmental Studies, Journal of Water Supply: Research and Technology-AQUA, Environmental Science and Pollution Research, Environmental Protection, Chemical Industry).

A detailed list of scientific achievements is presented in Annex 3.

A bibliometric analysis of publications shows (according to the Web of Science):

- Aggregate Impact Factor (in accordance withthe year of publication) -14.944
- The number of citation (excluding self-citations) - 24
- Hischa Index - 3
- Participation in one research project and two research and development projects
- Participation in 15 national conferences
- The development of six paper reviews (Environmental Protection Engineering, Ungineering of Environmental Protection)

For my scientific achievements, I received the Rector's Award in 2009 and 2013.

Bibliography:

1. Andersson A., Laurent P., Kihn A., Prévost M., Servais P. Impact of temperature on nitrification in biological activated carbon (BAC) filters used for drinking water treatment. Water Research 2001, 12, 2923-2934.
2. Bektaş N., Akbulut H., Inan H., Dimoglo A. Removal of phosphate from aqueous solutions by electro-coagulation. Journal of Hazardous Materials 2004,2, 101-105.

3. Berry D., Xi C., Raskin L. Microbial ecology of drinking water distribution systems. Current opinion in biotechnology 2006, 3, 297-302.
4. Biedroń I., Świderska-Bróż M., Traczewska T., Trusz-Zdybek A., Namysłowska-Wilczyńska B., Wolska M. The preliminary study of groundwater quality in the selected Kłodzko Valley area. Instal (Warszawa) 2013, 6, 41-44.
5. Biedroń I., Świderska-Bróż M., Traczewska T., Trusz-Zdybek A., Wolska M. The influence of the type of filter material on change of the value of selected indicators of groundwater quality. RocznikEnvironmental Protection 2013, 1, 845-862.
6. Bond T., Goslan E. H., Jefferson B., Roddick F., Fan L., Parsons S. A. Chemical and biological oxidation of NOM surrogates and effect on HAA formation. Water Research 2009, 10, 2615-2622.
7. Buchlerova H., Zajicova H. Water quality in distribution systems in Slovakia.. IV International Scientific - Technical ConferenceWater supply, water quality and protection WATER, Kraków 2000, 1081-1085.
8. Camper A.K. Involvement of humic substances in regrowth. International Journal of Food Microbiology 2004, 94, 355– 364.
9. Chang E.E., Chiang P.C., Hsing H.J., Yeh S.Y. Removal of model organic precursors by coagulation.Practice Periodical of Hazardous. Toxic and Radioactive Waste Management 2007, 69-76.
10. Chen C., Zhang X., He W., Lu W., Han H. Comparison of seven kinds of drinking water treatment processes to enhance organic material removal: A pilot test. Science of the Total Environment 2007, 1, 93-102.
11. Chiang P.C., Chang E.E., Liang C.H. NOM characteristics and treatabilities of ozonation processes. Chemosphere 2002, 46, 929–936.
12. Chien C.C., Kao C.M., Dong C.D., Chen T.Y., Chenj.Y. Effectiveness of AOC removal by advanced water treatment systems: A case study. Desalination2007, 202, 318–325.
13. Doll T. E., Frimmel F. H. Photocatalytic degradation of carbamazepine, clofibric acid and iomeprol with P25 and Hombikat UV100 in the presence of natural organic matter (NOM) and other organic water constituents. Water Research 2005,2, 403-411.
14. Flemming H.C., Percival S.L., Walker J.T. Contamination potential of biofilms in water distribution system. Water Science and Technology: Water Supply 2002, 2, 271-280.
15. Frimmel F.H., Saravia F., Gorenflo F. NOM removal from different raw waters by membrane filtration. Water Science Technology 2004, 4, 165–174.
16. Grochowiecka W., Świderska-Bróż M., Wolska M. Efficiency of the micro-sieve process towards the removal of phytoplankton organisms and some chemical pollutants from surface water. Environmental Protection. 2009, 31, 2, 25-30.
17. Haddix P.L., Shaw N.J.,LechevallierM.W. Characterization of Bioluminescent Derivatives of Assimilable Organic Carbon Test Bacteria. Applied and Environmental Microbiology2009, 23, 7385-7390.
18. Hałupka Z., Sosnowski S. Tap water protection in distribution system. GWiTS 1997, 12, 466-468.
19. Hashwa F., Tokajian S. Change of water quality in the distribution system of a residential area in Beirut. Mat. IV International Scientific - Technical Conference Water supply, water quality and protection WATERKraków 2000, 1125-1135.
20. Hernández I., Martínez-Aragón J. F., Tovar A., Pérez-Lloréns J. L., Vergara J. J. Biofiltering efficiency in removal of dissolved nutrients by three species of estuarine macroalgae cultivated with sea bass (Dicentrarchuslabrax) waste waters 2. ammonium. Journal of Applied Phycology 2004,5, 375-384.

21. Holden B., Gunstead J. Optimisation of water distribution systems. Mat. IV International Scientific - Technical ConferenceWater supply, water quality and protection Kraków 2000, 1137-1147.
22. Hrubec J., The hand book of environmental chemistry 5.B. Quality and treatment of drinking water. Springer – Verlag Berlin, Heidelberg 1995.
23. Huber S. A., Balz A., Abert M., Pronk W. Characterisation of aquatic humic and non-humic matter with size-exclusion chromatography–organic carbon detection–organic nitrogen detection (LC-OCD-OND). Water Research 2011, 2, 879-885.
24. Humbert H., Gallard H., Suty H., CrouéJ. P. Performance of selected anion exchange resins for the treatment of a high DOC content surface water. Water Research, 2005,9, 1699-1708.
25. Imoberdorf G., Mohseni M. Degradation of natural organic matter in surface water using vacuum-UV irradiation. Journal of Hazardous Materials 2011, 1, 240-246.
26. Jei-Cheol J., Chang-Hyun J., Ilhwan Ch., Soon-Buhm K. Ennkyung J., Tae-Munh. Analysis on the natural organic matter and disinfection by-products in full-scale advanced water treatment plant and conventional water treatment plant. Desalination and Water Treatment 2013, 31-33, 6288-6298.
27. Kaleta J., Puszkarewicz A., Papciak D. Removal of iron, manganese and nitrogen compounds from underground waters with diverse physical and chemical characteristics. Environment Protection Engineering 2007, 3, 5-13.
28. Kang S. H., Choi W. Oxidative degradation of organic compounds using zero-valent iron in the presence of natural organic matter serving as an electron shuttle. Environmental Science & Technology 2008, 3, 878-883.
29. Kim J., Kang B. DBPs removal in GAC filter-adsorber. Water Research 2008, 1, 145-152.
30. Kirisits M. J., Snoeyink V. L., Inan H., Chee-Sanford J. C., Raskin L., Brown J. C. Water quality factors affecting bromate reduction in biologically active carbon filters. Water Research 2001,4, 891-900.
31. Kleiser G., Frimmel F. H. Removal of precursors for disinfection by-products (DBPs)—differences between ozone-and OH-radical-induced oxidation. Science of the Total Environment 2000, 1, 1-9.
32. Kozyatnik I. P., Klimenko N. A., Savchina L. A. The effect of water ozonation on the efficiency of extracting natural organic matter during filtration through biologically activated carbon. Journal of Water Chemistry and Technology 2010, 3, 139-144.
33. Kurnatowska A. (red).The group work. Ecology it connection with different knowledge domains PWN, Warszawa-Łódź 2002.
34. Łebkowska M. Antibiotic Resistant Bacteria in Drinking Water. Environmental Protection 2009, 2, 11-15.
35. Łebkowska M., Pajor E., Rutkowska-Narożniak A., Kwietniewski M., Wąsowski J., Kowalski D. Microbialgrowth in cement-lined ductile cast-iron water-pipe networks.EnvironmentalProtection 2011, 3, 9-13.
36. Lethola M.J., Miettienen I.T., Vartiainen T., Martikainen P.J. Changes in content of microbially available phosphorus, assimilable organic carbon and microbial growth potential during water treatment processes. Water Research 2002, 15, 3681-3690.
37. Mac Kenzie W. R., Hoxie N. J., Proctor M. E., Gradus M. S., Blair K. A., Peterson D. E., Davis J. P. A massive outbreak in Milwaukee of Cryptosporidium infection transmitted through the public water supply. New England Journal of Medicine 1994,331, 161-167.
38. Mains C. Biofilms control in distribution system. Tech Brief, National Environmental Service Center (NESC), Summer 2008, 2.
39. Markowski J., SymonowiczC.,Stanislawiak R. On the utility of the micro-sieve operated by the Zawada water treatment plant. Environmental Protection 2006,1, 35-38.

40. Matilainen A., Vepsäläinen M., Sillanpää M. Natural organic matter removal by coagulation during drinking water treatment: A review. Advances in Colloid and Interface Science 2010, 2, 189-197.
41. Michaud L., Blancheton J. P., Bruni V.,Piedrahita R. Effect of particulate organic carbon on heterotrophic bacterial populations and nitrification efficiency in biological filters. Aquacultural Engineering2006, 3, 224-233.
42. Miettinen I.T., Vartiainen T., Martikainen P.J., Phosphorus and bacterial growth in drinking water. Applied and Environmental Microbiology 1997, 8, 3242-324.
43. Ndergaard M.S., Worm Y. Measurement of biodegradable dissolved organic carbon (BDOC) in lake water with a bioreactor. Water Research 2001, 10, 2505–2513.
44. Norton C. D., Lechevallier M. W. A pilot study of bacteriological population changes through potable water treatment and distribution. Applied and Environmental Microbiology 2000, 1, 268-276.
45. Olańczuk-Neyman K. . Microorganisms In Shaping The Quality And Groundwater Treatment, Monographs The Environmental Engineering Polish Academy of Sciences, Gdańsk 2001.
46. Papciak D., Kaleta J., Puszkarewicz A. Removal of ammonia nitrogen from groundwater on chalcedony deposits in two-stage biofiltration process. Annual Set The Environment Protection 2013, 2, 1336-1351.
47. Parsons S. Advanced oxidation processes for water and wastewater treatment. IWA publishing. 2004
48. Parveen S., Hodge N. C., Stall R. E., Farrah S. R., Tamplin M. L. Phenotypic and genotypic characterization of human and nonhuman Escherichia coli. Water Research 2001, 2, 379-386.
49. Phe M.H., Dossot M., Guilloteau H., Block J.C. Nucleic acid fluorochromes and flow cytometry prove useful in assessing the effect of chlorination on drinking water bacteria. Water Research2005, 39, 3618–3628.
50. Pitkänen T., Miettinen I.T., Nakari U.M., Takkinen J., Nieminen K., Siitonen A., Kuusi M., Holopainen A., Hänninen M.L. Fecal contamination of a municipal drinking water distribution system in association with Campylobacter jejuni infections. Journal Water Health. 2008, 3, 365-376.
51. Plummer J.D., Edzwald K.J. Effect of ozone on algae asprecursors for trihalomethane and haloacetic acid production. WaterScience& Technology2001, 35, 3661–3668.
52. Polanska M., Huysman K., Keer Ch. Investigation of assimilable organic carbon (AOC) in Flemish drinking water. Water Research 2005, 39, 2259–2266
53. Raczyk-Stanisławiak U., Świetlik J., Dąbrowska A., Nawrocki J. Biodegradability of organic by-products after natural organic matter oxidation with ClO2—case study. Water Research 2004, 4, 1044-1054.
54. Reungoat J., Macova M., Escher B. I., Carswell S., Mueller J. F., Keller J. Removal of micropollutants and reduction of biological activity in a full scale reclamation plant using ozonation and activated carbon filtration. Water Research 2010, 2, 625-637.
55. Sarasa J., Cortés S., Ormad P., Gracia R., Ovelleiroj.L. Study of the aromatic by-products formed from ozonation of anilines in aqueous solution. Water Research 2002, 12, 3035-3044.
56. Sarathy S. R., Mohseni M. The impact of UV/H_2O_2 advanced oxidation on molecular size distribution of chromophoric natural organic matter. Environmental Science & Technology 2007, 24, 8315-8320.
57. Sarathy S., Mohseni M. The fate of natural organic matter during UV/H2O2 advanced oxidation of drinking water. Canadian Journal of Civil Engineering 2008, 1, 160-169.
58. Serodes J.B., Rodriguez M.J., Li H., Bouchard Ch. Occurrence of THMs and HAAs in experimental chlorinated waters of the Quebec City area (Canada). Chemosphere 2003, 51, 253–263.

59. Sharp, E. L., Parsons, S. A., Jefferson, B. Seasonal variations in natural organic matter and its impact on coagulation in water treatment. Science of the Total Environment 2006,1, 183-194.
60. Świderka-Bróż M., Wolska M. Major contributors to self-contamination of water in distribution system. Environmental Protection 2006, 4, 29-34.
61. Świderska-Bróż M., Water recontamination in distribution system. Conference: Microcontaminants in Human. Częstochowa 2000.
62. Świderska-Bróż M., Wolska M. Effects of Granulated Acive Carbon Bed Regeneration of Dissolved Organic Carbon Removal from Surface water. Polish Journal of Environmental Studies 2015, 2, 717-723.
63. Świderska-Bróż M., Wolska M. Causes underlying free chlorine decay In the water distribution system. Environmental Protection 2009, 4, 19-24.
64. Świderska-Bróż M., Wolska M. Efficiency of ozonation followed by filtration through a biologically active adsorption bed at removing biogenic organic substances from surface water. Environment Protection Engineering. 2012, 2, 19-28.
65. Świderska-Bróż M., Wolska M. The principal parameters of water quality deterioration in distribution system . Engineering &Protection of Environment 2005, 2, 159-169.
66. Świderska-Bróż M., Wolska M. The Principal Parameters of Water Quality Deterioration in Distribution System. In: Microcontaminant in Human Environmental 2004, 11-19.
67. Świderska-Bróż M., Wolska M. Influence of hydraulic parameters on water pollution in a distribution system. Environment Protection Engineering 2007, 4, 5-16.
68. Świderska-Bróż M., Wolska M. Recontamination of chemically unstable water in the distribution system.Environmental Protection 2005, 4, 35-38.
69. Świderska-Bróż M., Wolska M. Variations in the bio-stability of infiltration water in the treatment train Environmental Protection 2012, 4, 63-68.
70. Świderska-Bróż M., Wolska M. Efficiency of contact coagulation in removing biogenic substances from water. Environmental Protection 2010, 2, 3-7.
71. Świderska-Bróż M., Wolska M. Efficiency of surface water treatment processes at removing biodegradable organic substances. EnvironmentalProtection. 2011, 4, 77-80.
72. Świderska-Bróż M., Wolska M. Removal of total organic carbon fractions from surface water by coagulation.Environmental Protection 2011, 1, 9-12.
73. Świderska-Bróż M., Wolska M. Influence of hydraulic parameters on water secondary contamination in distribution system. In: II Environmental Engineering Kongres. Lublin: 2005, 509-517.
74. Świderska-Bróż M., Wolska M. Water pollution with iron corrosion products in water supply systems. GWiTS 2008, 4, 17-20.
75. Świderska-Bróż M., Wolska M. Changes of organic substances concentration in water during chemical oxidation. Engineering & Protection of Environment 2011, 2, 111-120.
76. Świetlik J., Dąbrowska A., Raczyk-Stanisławiak U., Nawrocki J. Reactivity of natural organic matter fractions with chlorine dioxide and ozone. Water Research 2004,3, 547-558.
77. Szlachta M., Adamski W. Effects of natural organic matter removal by integrated processes: Alum coagulation and PAC-adsorption. Water Science& Technology 2009, 10, 1951–1957.
78. Tatara M. Secondary water pollution in water supply systems in the process of its distribution in the aspect of physic-chemical water quality decrease. GazWodaiTechnikaSanitarna 2001, 6,201-205.
79. Tung H. H., Xie Y. F. Association between haloacetic acid degradation and heterotrophic bacteria in water distribution systems. Water Research 2009, 43, 971–978.
80. Von Gunten U. Ozonation of drinking water: Part I. Oxidation kinetics and product formation. Water Research 2003,7, 1443-1467.
81. Vreeburg I. J., Boxall J. B. Discolouration in potable water distribution systems: A review. Water Research 2007, 41, 519-529.

82. Wang H., Ho L., Lewis, D. M., Brookes J. D., Newcombe G. Discriminating and assessing adsorption and biodegradation removal mechanisms during granular activated carbon filtration of microcystin toxins. Water Research 2007,18, 4262-4270.
83. Włodyka-Bergier A., Bergier T. Characterization of Precursors to volatile water chlorination by-products in the Krakow water distribution system. Environmental Protection 2011, 3, 29-33.
84. Wolska M. Biological stability of water in water distribution systems: the effect of water treatment trials. Environmental Protection Engineering 2015, 2. (paper accepted for publication)
85. Wolska M. Changes in water biostability levels during an ion-exchange process using Miex-DOC resin. Journal of Water Supply: Research and Technology AQUA doi:10.2166/aqua.2015.129
86. Wolska M. Changes in water biostability levels in water treatment trials. Water Science &Technology 2015, 4, 538-544.
87. Wolska M. The Change in Fractions of Organic Substances in Water in the Intermediate Oxidation Process. Desalination and Water Treatment 2015, 1-6.
88. Wolska M. Influence of structure of natural organic compounds on adsorption efficience. Cemical Industry 2015, 6. (paper accepted for publication)
89. Wolska M. Efficiency of removal of biogenic substances from water in the process of biofiltration. Desalination and WaterTreatment 2015, s. 1-7.
90. Wolska M. Removal of precursors of chlorinated organic compounds in selected water treatment processes. Desalination and WaterTreatment 2014, 19-21, 3938-3946.
91. Wolska M. The efficiency of coagulation and sedimentation in removal of biogenic substances .Cemical Industry 2008, 5, 619-622.
92. Wolska M. An evaluation of organic substance fraction removal during ion exchange with MIEX-DOC resin. Environmetal Science and Pollution Research. DOI: 10.1007/s11356-015-4685-2.
93. Xing W., Ngo H. H., Kim S. H., Guo W. S., Hagare P. Adsorption and bioadsorption of granular activated carbon (GAC) for dissolved organic carbon (DOC) removal in wastewater. Bioresource Technology 2008, 18, 8674-8678.
94. Xu B., He Y.J. Production practice of biological pretreatment and advanced treatment in waterworks in Jiaxing region. China Water Wastewater 2007, 23, 56–58.
95. Zimoch I. Assessing spatial variations of water quality in the water-pipe network by analysis of THM formation. Environmental Protection 2007, 4, 49-52.
96. Zimoch, I. Monitoring of the quality of the water in water-pipe networks: reliability interpretation of the results. Environmental Protection 2009, 4, 51–55.

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