Auto-abstract
on the achievements of scientific and research activities as well as teaching and organizational work

CONTENTS

1. FULL NAME

Agnieszka Elwira Tuszyńska

2. DIPLOMAS AND SCIENTIFIC DEGREES HELD

2001 - Obtaining a Master of Science degree majoring in environmental engineering with specialization in sanitary engineering at the Department of Hydraulic Engineering and Environmental Engineering of Gdańsk University of Technology (presently the Department of Civil and Environmental Engineering), the title of the master's thesis "Project of wastewater treatment plant for the village Bryzgiel with p.e. = 1000 lying in Wigry National Park "

2005 - Obtained the degree of doctor of technical sciences in engineering specializing in environmental water and wastewater technology at the Department of Civil and Environmental Engineering at the Gdańsk University of Technology, the title of his doctoral thesis "The influence of organic matter on oxygenation and contaminant removal efficiency in wetlands deposits"

3. THE COURSE OF EMPLOYMENT IN RESEARCH UNITS

2001 - 2005 - Doctoral Studies listener "Geotechnical and Environmental Engineering" at the Department of Hydraulic Engineering and Environmental Engineering (presently the Department of Civil and Environmental Engineering), Gdańsk University of Technology

2006 - 2008 – Teaching assistant in the Department of Water and Wastewater Technology at the Department of Civil and Environmental Engineering, Gdańsk University of Technology

2006 - 2008 - Position of assistant professor in the Department of Heating and Ventilation at the Department of Civil and Environmental Engineering University of Technology and Agriculture (presently the Faculty of Engineering, Architecture and Environmental Engineering, University of Technology and Life Sciences in Bydgoszcz)

2008 - 2012 - Position of assistant professor in the Department of Water and Wastewater Technology at the Faculty of Civil and Environmental Engineering, Gdańsk University of Technology

2011 - Until now - academic teaching position at the Department of the Engineering School of Environmental Management in Tuchola

2012 - Until now - the position of assistant professor in the Department of Sanitary Engineering at the Faculty of Civil and Environmental Engineering Gdańsk University of Technology

4. INDICATION OF ACHIEVEMENTS ARISING FROM ART. 16, 2 ACT FROM 14.03.2003 ABOUT RESEARCH AND SCIENTIFIC DEGREES AND TITLES AND ON DEGREES AND TITLES IN THE SCOPE OF ART (Official Journal No. 65, item. 595, as amended.)

4.1. TITLE OF ACHIEVEMENT

A series of monothematic publications: ***"Transformation of organic matter and phosphorus compounds in wastewater treatment of ecological purification systems"***.

4.2. PUBLICATIONS FORMING THE ACHIEVEMENT

1. **Tuszyńska A**., Obarska-Pempkowiak H. **(2008)** *Dependence between quality and removal effectiveness of organic matter in hybrid constructed wetlands.* Bioresource Technology 99: 6010-6016. **MniSW (Ministry of Science and Higher Education) Scoring: 45 IF: 5,6**

2. **Tuszyńska A.,** Obarska-Pempkowiak H. **(2008)** *Effect of oxygenation of wetland deposits on contaminant removal efficiency.* Annual Magazine - Environmental Protection 10: 413-425.
MniSW (Ministry of Science and Higher Education) Scoring 15 IF: 0,735

3. **Tuszyńska A**., Obarska-Pempkowiak H. **(2009)** *Speciation of organic matter in vertical flow constructed wetlands*. Polish Journal of Environmental Studies 18(4): 735-740.
MniSW (Ministry of Science and Higher Education) Scoring: 15 IF: 0,762

4. **Tuszyńska A**., Obarska-Pempkowiak H. **(2010)** *Influence of added organic matter on the quality of the performance and operation of constructed wetlands.* Chemical Industry 7: 958 -962.
MniSW (Ministry of Science and Higher Education) Scoring: 15 IF: 0,356

5. **Tuszyńska A.,** Kołecka K. **(2011)** *The influence of granulometric content on the quality of water pollution and wastewater treated in ecological systems.* Gas, Water and Sanitary Engineering 12: 486-490.
MniSW (Ministry of Science and Higher Education) Scoring: 5 IF: 0

6. **Tuszyńska A.,** Kołecka K. **(2012)** *Analysis of bottom sediments in terms of their fertilizing properties.* Ecology and Technology 4: 259-266.
MniSW (Ministry of Science and Higher Education) Scoring: 5 IF: 0

7. **Tuszyńska A.,** Kołecka K. **(2012)** *Particle size analysis of suspensions in removing of organic matter and phosphorus from wastewater and surface water*. ACEE Journal 4: 113- 119.
MniSW (Ministry of Science and Higher Education) Scoring: 4 IF: 0

8. **Tuszyńska A.,** Kołecka K. **(2012)** *Fractions of phosphorus in bottom sediments and their bioavailability during tertiary treatment in ecological systems.* Marine Engineering and Geotechnics 3: 179-188. **MniSW (Ministry of Science and Higher Education) Scoring: 3 IF: 0**

9. **Tuszyńska A.,** Kołecka K., Quant B. **(2013)** *The influence of phosphorus fractions in bottom sediments on phosphate removal in semi-natural systems as the 3rd stage of biological wastewater treatment.* Ecological Engineering 53: 321- 328.
MniSW (Ministry of Science and Higher Education) Scoring: 35 IF: 3,479

Summary of publications with a score (according to the Regulation by the Ministry of Science and Higher Education related to the scientific journals dated July 13, 2012) and the percentage of participation in the preparation of publications by assistant professor candidate.

Position	***Number of points***	***The percentage of participation In the publication***	***The number of points taking into account the participation***	***Impact Factor****
Ad. 1	45	50	22,5	5,6
Ad. 2	15	50	7,5	0,735
Ad. 3	15	50	7,5	0,762
Ad. 4	15	50	7,5	0,356
Ad. 5	6	90	5,4	0
Ad. 6	5	90	4,5	0
Ad. 7	4	80	3,2	0
Ad. 8	4	90	3,6	0
Ad. 9	35	90	31,5	3,479
Sum	**144**	**-**	**93,2**	**10,932**

** IF during the 5-year period*

4.3. DISCUSSION ABOUT THE PURPOSE OF THE ABOVE MENTIONED SCIENTIFIC WORK AND ASSOCIATED WITH IT FINDINGS AND THEIR POSSIBLE IMPLEMENTATION

Ecological Treatment Systems – ETS are based on being implemented in Western Europe and North America systems known as "constructed wetlands", whose work simulates hydraulic conditions and natural habitat wetland ecosystems. Soil-plant wastewater treatment method is occurring biological process involving heterotrophic microorganisms and water-loving plants as they exist in a properly designed systems with surface wastewater flow called Free Water Surface - FWS or subsurface wastewater flow treatment called Vegetated Submerged Beds - VSB.

Due to the specific conditions for the growth of plants intensifying processes of oxidation and reduction, which - supported by processes of sorption, sedimentation and assimilation - allow removal of a substantial part of the impurities from the waste water. So far, ecological purification systems used to remove pollutants from point sources (constructed wetlands) and area sources (buffer zone plants) and partial dewatering and disposal of sewage sludge. The advantage of these systems is the ability to intensify and control some of the processes taking place in them.

The ability of the ETS objects for removing impurities from waste water depends on a number of environmental factors, which include the variables to be among others: changing oxygen conditions, temperature, and the pH effluent or the cargo load of organic substances. In contrast, prolonged hold of sewage in these systems helps sedimentation of the polluted matter. So far, inside the ETS objects studies were conducted on the removal efficiency of organic matter and biogenic

compounds. It is not known, however, much of the fractions in which they occur and their ability to transform and their bioavailability in both the wastewater flowing through the system, as well as sediments arising during their purification. Recent literature reports indicate that the compounds of the nutrients and the organic substance in the form of a slurry, and dissolved with the wastewater supplied to the organic decontamination systems may be subject to further transformations. The dynamics of the transformation of these pollutants is influenced, among others, by the aerobic and the anaerobic conditions, carbonate imbalance, or by UV radiation.

Therefore, I conducted tests in order to verify two hypotheses saying that:

1) The efficiency of removal of organic matter from wastewater in ecological purification facilities depends on the fractions in which it appears and their concentrations;

2) depending on the changing conditions of the physico-chemical processes in ecological purification systems changes of phosphorus speciation in sediments forms occur, thereby changes of the conditions of equilibrium between the wastewater phosphorus and sediment occur as well, which affects the efficiency of phosphorus removal in these facilities.

Ad. 1.

In order to verify the first hypothesis, I conducted an analysis of the work of the three ETS objects of VSB type working in two different configurations with variable vertical and horizontal subsurface flow of wastewater. The configuration of the first horizontal bed located at the beginning of biological treatment, I analyzed using the example of two objects in the Pomeranian province. The second configuration with the vertical bed designed as the first stage of the treatment was analyzed based on facility located in Germany.

Samples of wastewater were collected by me once a month in a two-year study period, respectively at the inlet, the subsequent stages of purification and outflow of the facilities. For the amount of organic matter removed during wastewater flow through different parts of purification of waste water samples I marked total suspended solids and organic matter is susceptible to biochemical decomposition expressed in BOD and total - expressed in COD. I've performed speciation of organic matter in order to determine the type and participation of dissolved biodegradable organic compounds (S_S) and non-degradable (inert) (S_I) and the organic slurry susceptible to degradation (X_S) and the hard biodegradable (X_I), in accordance with the methodology specified in the German guidelines ATV-131 (1995)[1]. The procedure related to the determination of individual forms of organic matter called speciation in accordance with the terminology used in chemical analysis. Determination of physico-chemical treatment plants I have performed according to the Collection of Polish Norms[2] as well as in accordance with the German norms[3].

Obtained by me results revealed that in all analyzed facilities concentrations of organic substances in fractions X_S, X_I and S_S after further purification steps have been reduced, while the concentration in the effluent fraction SI after subsequent purification steps were the same as in the feed to the facilities.

From the characteristics of the influent wastewater to a facility in Wiklino showed that after the mechanical wastewater treatment (in the settlement stage), 48.2% of the total COD was a fraction of organic slurries susceptible to biodegradable process (X_S). However, after further purification steps its content in the wastewater has been significantly reduced. Similarly, the percentage fraction of biologically hardly degradable slurries (X_I) and dissolved organically biodegradable items (S_S) in the waste water outlet also decreased.

The value of the percentage of the fraction XS in the influent wastewater to the facility in Wieszyno was similar to that obtained in the treatment plant in Wiklino. However, after further purification steps had not recorded a considerable drop in the concentration of the fraction X_S with respect to COD, as it did during the analysis of the work at the facility in Wiklino. Also, the percentage of fraction X_I in wastewater after successive stages remained at a similar level and averaged approx. 17%.

From the characteristics of the influent wastewater to an object in Germany it showed that in

influent wastewater 25.4% of the total COD was biodegradable organic slurries fraction and percentage of this fraction in the effluent wastewater was twice lower than in the facilities analyzed in Poland. Lower fraction of X_S in the wastewater was a result of the use of treated wastewater recirculation at the beginning of the purification system. After further purification steps concentrations of the fractions X_S and the fraction X_I underwent significant reduction. Eg the percentage of fraction X_I in wastewater flowing into the facility amounted to 15.8%, while in the treated wastewater - 6.0%. Similar results appeared to the fraction S_S. The treated wastewater concentration of dissolved organic biologically degradable compounds was six times lower compared to the wastewater flowing into the facility.

The treated wastewater in all the analyzed facilities showed the largest percentage share representing the fraction of inert organic compounds.

The study allowed me to conclude that the organic matter present in the suspension susceptible to degradation (X_S) and the one biologically difficult to be degradable (X_I), significantly affected the ability of sewage to their biodegradability and determined the efficiency of removal of contaminants in the analyzed facilities. Their high levels of concentration in wastewater contributed to the reduction of purification efficiency. Sewage, which was characterized by a higher proportion of organic matter present in the suspension - X_S decomposed much slower than the waste water, in

which the dominant dissolved organic substance was - S_S. By analyzing wastewater samples I have observed that in the treated wastewater in Wieszyno was a lot of suspension, and in Wiklino - wastewater characterized by significant concentration of biodegradable solute. The results obtained showed that the wastewater having a quotient $X_S+X_I/S_S+S_I < 1,6$ were cleaned from impurities in the fields most effectively (over 90%). For plants with a quotient $X_S/S_S > 2,8$ contaminant removal efficiency decreased by an average of 25%.

Ad. 2.

Phosphorus, which is in sludge, occurs in the form of phosphates loosely related with complex compounds as well as phosphates adsorbed on organic and inorganic substances. As a result of biotic and abiotic processes occurring part of the phosphorus in the sediments in the form of chemical compounds dissolves and is re-released into the sewage. The basic factors affecting this process include: content of oxygen, pH and oxidation-reduction potential. Also temperature has an important influence as well as structure and hydration of sludge and the type of chemical compounds in which phosphorus is present in the sediments. The durability of phosphorus in the sediment deposit or release rate is determined by the nature of the chemical bonds in which this element is present. Mobility and bioavailability of these compounds depends on their solubility. Thus, phosphorus may form connections (fractions) of different capacity for its release to the environment. Examination of the mobile forms of phosphorus in the sediments is of vital importance in assessing the amount of phosphorus, which is released as a result of the chemical dissolution of minerals and microbial decomposition of organic matter is re-incorporated into the biological cycle, causing an increase in primary production.

The first studies of speciation of phosphorus were conducted for the soil, much later for the bottom sediments of lakes and sewage sludge. Up until now the presence of phosphorus forms (i.e. Speciation) in sediments generated during wastewater purification in ecological systems was not examined.

In order to verify the second hypothesis, I conducted research in three ecological purification systems located in the Pomeranian province. Wastewater sample for testing I took once a month for two years at inlet and outlet of the ETS facilities, taking into account the sensitivity of these systems appearing at the beginning, middle and the end of the vegetative season, when among plant populations greatest changes occur. The marking of concentrations of pollutants (eg organic matter, total phosphorus and phosphate phosphorus) in the waste water was conducted in accordance with the Polish standards.

In order to determine the prevailing physico-chemical conditions in the analyzed facilities, every time each I have performed measurements of the oxygen content, pH and temperature with the help of the German electronic probes manufactured by WTW. The samples of sediment I took along the vertical profile of the analyzed objects. I cut the sediment profiles into 10-centimeter layers and analyzed each of them separately. During the study I've analyzed the four methods of phosphorus speciation in sediments: BCR[4], Williams[4], Golterman[5] and Psenner[6]. These methods differ in the number of separated fractions. BCR method permits to separate the phosphorus adsorbed in the sediment into 3 fractions, whereas the Golterman method into 4 fractions and Williams and Psenner methods into 5 fractions differing in solubility.

The study allowed me to point out that the Psenner method, although very time-consuming, was the most appropriate analytical technique for assessing the quality and concentration of phosphorus in the sediment fractions from ETS systems. According to Psenner the form with the highest bioavailability of phosphorus is the one loosely sorbed on the surface of sludge (the fraction NH_4Cl-P). Very mobile is also phosphorus in association with oxides and iron ixides (Fe-P fraction). The phosphorus inside of organic matter, expressed as a fraction of NaOH-P, is also considered bioavailable. Remaining phosphorus is present in combinations with calcium and magnesium (HCl-P fraction) and in the other, practically insoluble compounds of a mineral and organic fraction (Res.-P). Phosphorus loosely sorbed onto the particles sediment was extracted by me for one hour with 1-molar solution of NH_4Cl, and the phosphorus present in combinations with iron - a mixture (ratio 1: 1) 0,11-molar of $NaHCO_3$ and 0,11-molar $Na_2S_2O_4$ for two hours. The phosphorous associated with organic matter I've extracted for 18 hours with 1-molar solution of NaOH and phosphorous present in combination with calcium and magnesium - 0.5 molar HCl also for a period of 18 hours. After each extraction step I spun the sample and the supernatant solution was blended. Residual sludge I flooded with next-reagent. The solution obtained after each extraction step I've neutralized and marked the phosphorus phosphate content via the molybdate method. Phosphorus in the sediment remaining after the fourth stage of the extraction, i.e. Res.-P fraction, I've marked by burning the sample in perchloric acid.

Analysis of the quantitative participation of speciation phosphorus forms in sediment profiles from ETS facilities provided important information on the accumulation durability and the possibility of the secondary release of these elements into the wastewater. Content of phosphorus fraction with the highest bioavailability in sediments taken from objects from Swarzewo and Kartuzy was small and averaged 7.0%. Along with the increasing depth its participation in the sludge profile was increasing - in the surface layer constituted 4.0% but in the oldest layer - 10.0% P_{total}. I observed the opposite situation for the sediments in the Żarnowiec facility. The share of phosphorus in the fraction

of NH_4Cl-P has averaged 46.4% and accounted for the highest share in comparison with the other fractions, in which phosphorus is present. With increasing depth part of this fraction was slightly reduced from 46.9 to 44.4%.

Very mobile is also phosphorus present in combination with iron (Fe-P fraction). The sediments from Swarzewo showed phosphorus content of this fraction three times higher than that of phosphorus contained in the fraction NH_4Cl-P. The average value was 2.47 mgP / gs.m, which accounted for 19.9% of the average fraction of Fe-P in the sediments. The lowest content was found in the surface layer - 1.5 mgP/gs.m., and the highest in the oldest layer - 3.2 mgP/gs.m. I observed the opposite situation for sludge from Żarnowiec. Here fraction of Fe-P while progressing in depth decreased and was 8.5% in the surface layer, and 4.4% at a depth of 20 cm. The decline in the share of phosphorus in the fraction of HCl-P along the profile of sediments taken from Żarnowiec showed an intense release of this element of the sediments. The property in the period under study was dominated by anaerobic conditions, which contributed to the reduction of Fe^{3+} to Fe^{2+} and thus to dissolve the complexes of Fe-P and the re-release of phosphate ions to wastewater.

In all the analyzed facilities dominant form of phosphorus in sediments was representing the fraction of NaOH-P (from 41.5 to 51.9% of total phosphorus contained in the sediment). I found a significant correlation (r = 0.79) between the content of organic matter in the sediment and phosphorus content in the fraction of NaOH-P. The results allowed me to conclude that the majority of phosphorus accumulated in the sediments of analyzed facilities ETS performed in combination with hard degradable suspension fraction and susceptible to biodegradation. In Swarzewo and Kartuzy fraction NaOH-P was along the depth profiles of sludge reduced by approx. 70% in the surface layer to 40.0% at a depth of 30 cm. The decline in the share of phosphorus in the fraction of NaOH-P profiles along sediment showed during intense release of this element from the sediments. During the study period was aerobic conditions dominated, which contributed to the intense mineralization of organic matter and thus to re-release of phosphate ions to wastewater. In good aerobic conditions phosphorus release by far outweighed the deposit process, leading to lower fraction of NaOH-P in the sediments.

The fraction of phosphorus bound with calcium and magnesium (HCl-P) is less mobile than the three I discussed earlier. The analyzed average content of phosphorus in the form of sediment was ranging from 3.0% to approx. 16% P_{total}. I also observed that for all analyzed facilities, its share was increasing with depth in sediment profiles. The availability of this form of phosphorus is largely associated with erythrocyte of the sewage flowing through the ETS systems. At pH values from ranging from 7.2 to 8.5 precipitations of phosphate ions in the form of calcium phosphate can be observed. Analyzed wastewater characterized by similar values of pH, which resulted in the

formation of water-insoluble calcium phosphorous connections and its accumulation in the sediments. Practically unavailable phosphorus is also available in a group of compounds designated as fraction Res.-P. Analysis of sediment profiles showed that the percentage of the discussed fraction of the total phosphorus was small and amounted to an average of 1.3% - in Żarnowiec and up to 7.0% P_{total} – in Kartuzy. The amount of phosphorus contained in this fraction was not significantly correlated with either the organic matter content or the total phosphorus in the sediments. This indicates a little importance in of this fraction in releasing and depositing of phosphorus.

The most important achievements arising from the research:

1. Research results confirm the hypothesis posed in the work that *the removal efficiency of organic matter from wastewater in organic purification facilities depends on the fractions in which they're present and their concentrations, and that, depending on the changing conditions occurring in environmental physico-chemical purification systems, the speciation phosphorus forms in sludge also change and thereby the conditions of equilibrium between the phosphorus waste water and sediment change, which affects the efficiency of phosphorus removal of these objects.*

2. According to the best of my knowledge the first time in Poland these activities were carried out:
- Speciation of organic matter in the wastewater treated at the ETS facilities;
- Research on the occurrence of phosphorus forms in sediments formed during the wastewater purification at the ETS systems.

3. The organic matter present in the suspension susceptible to decay and hardly biologically degradable had a significant impact on the ability of wastewater to become biodegradable and determined the high efficiency of removal of impurities in the analyzed facilities.

4. It has been shown that in the treated wastewater organic substance appeared mainly in dissolved fraction not susceptible to biological degradation (inert).

5. Fractionation of phosphorus by utilizing the Psenner method is the most appropriate analytical technique for assessing the quality and concentration of phosphorus fractions in the sediment from ETS systems.

6. The conducted analysis of quantitative ratios of phosphorus fractions of different mobility has provided important information on the sustainability of accumulation and the rate of release of this element from the sludge to the wastewater. Central role in the re-release of phosphorus in wastewater served two phosphorus fractions: bound to the organic substance and bound with iron.

Quantitative changes in these fractions in sediments influenced the growth of the phosphate concentration in the effluent.

To sum up, the results are important to assure proper operation and exploitation of ecological purification systems. Cognitive outcome of this study was the identification of the fractions of organic matter and phosphorus and their transformation during wastewater purification in ecological systems. The analysis of the study allowed us to determine the importance of speciation of organic matter and phosphorus compounds in evaluating the effectiveness of ETS wastewater treatment systems. This knowledge should be taken into account particularly when designing ETS facilities for wastewater treatment dealing with disadvantaged compositions or when required is very effective removal of phosphorus and organic matter in order to protect surface waters from eutrophication.

5. OVERVIEW OF OTHER SCIENTIFIC RESEARCH ACHIEVEMENTS

5.1 BEFORE RECEIVING THE DOCTOR'S DEGREE

In 1996 I began his studies at the Gdańsk University of Technology at the Department of Environmental Engineering (now the Department of Civil and Environmental Engineering). Being in the fourth year of studies has I conducted professional practice in design and construction company EKOBUDEX sp. (Pomeranian province), where I conducted research on alternative ways of managing rainwater. After five years of study I've obtained a Master of Science degree majoring in environmental engineering with specialization in sanitary engineering. The master's thesis was "The SBR wastewater treatment plant project for the village Bryzgiel located in the Wigry National Park" which was performed under the guidance of Dr. Hab. Eng. Bernard Quant, Prof. Post Graduated (PG) work I've defended on 25 June 2001 with the very top grade.

Immediately after graduation I began my doctoral studies in geotechnical and environmental engineering under the supervision Assoc. Prof. Eng. Hanna Obarska-Pempkowiak who made me interested in wastewater problems and how to solve them using the wetlands method. In 2003, the proposed scope of the study received financial aid in the form of the PhD research project sponsored by the Ministry of Science and Informatics. Project title was "Determination of the respiratory capacity of wetlands and filters in domestic wastewater treatment plants during their operation" registered as no 3T09604926. Doctoral dissertation titled "The influence of organic matter on oxygenation and efficiency of removal of pollutants in wetland deposits " I defended on 14 December 2005 at the Department of Civil and Environmental Engineering, Gdańsk University of Technology with a doctorate in technical sciences in environmental engineering, specializing in water and

wastewater technology. The aim of the experiment was to identify the dynamics of the distribution and accumulation of organic matter in wastewater irrigated wetland fields, as well as identifying conditions to exclude its accumulation in the soil. The research results have contributed to the development of guidelines for the design of subsurface deposits flow wetland plants. The results of the research related to the topic of my dissertation, which I conducted during doctoral studies, I've published in 16 peer-reviewed publications, including two journals with Impact Factor.

During my doctoral studies I went on numerous international internships in German research centers (Technische Universität in München, Fraunhofer Gesellschaft in Stuttgart) and state owned (Bayerisches Staatsministerium für Umwelt Gesundheit und Verbraucherschutz; Wasserwirtschaftamt in Nürnberg; Wasserwirtschaftamt in München) and participated in vocational courses in design and construction operating conducted in companies in Munich and Berlin (Fa. AKUT GmbH; Fa. Schlegel GmbH & Co.KG). In 2003 in the context of research training in the Bavarian water management offices in Germany (WWA-Hof; WWA-Nürnberg and WWA-München) I could acquaint myself with the modern ecological engineering technologies, the basics of water rights of the European Union, Germany and Bavaria and integrated water resources management in accordance with the guidelines of Agenda 21. Two years later I became a Fellow of the DAAD (Deutsche Akademische Austauschdienst) and took a six-month long research internship at the Department of Water Protection and Waste Management (Lehrstuhl und Laboratorien für Wassergüte und Abfallwirtschaft) at the Technical University of Munich (Technische Universität in München), where under the supervision of Professor. Peter Wilderer I conducted research related to my doctoral dissertation.

While in Germany, I've also participated in the courses and seminars to raise my academic qualifications. They concerned the microbiological analysis of activated sludge (course run by ATV-DVWK in Augsburg), while at the invitation of the Bavarian Ministry of the Environment I've twice took part in seminars devoted to Integriertes Wasser Ressource Management (Integrated Water Resource Management).

In parallel with the scientific work I was gaining the experience. As an assistant of the designer I held internships at German design-consulting companies being active in the executive field of sanitary engineering. I was responsible, among others duties, for the preparation of the concept, design and technical documentation for the sewage treatment of a municipal plant. In addition, I participated in the design and executive water supply and sanitary sewage. Completed projects and supervision of the construction of these facilities allowed me to win, so important in the work of the technical college, professional experience. Among others, in the period between 2004 and 2005 as part of a partnership project of bfz GmbH and SINAENCO I was a designer and coordinator of the

construction of wetland treatment plant related to a biological treatment of wastewater from the textile industry for the town Toritama in Brazil. While in Brazil, at the invitation of the University of Recife I gave a presentation on natural methods of wastewater treatment (est. 4, pos. A8-15). Cooperation with German research centers also resulted in a number of German-language publications in professional journals (est. 4, pos. A6-10, B6-19, B6-31, B6-35). Research internships in Germany have developed my skills and organizational research. I learnt new experimental techniques; I made numerous contacts with scientists from Germany. Started cooperation continues to this day. Since 2004, I am a member of the International Water Technology Transfer Project (Project Technologietransfer Wasser - TTW), based in the Bavarian Ministry of the Environment (est. 12, pos. 2).

5.2. AFTER I RECEIVED MY DOCOTOR'S DEGREE

In addition to my scientific achievement, my research work representing my academic achievements can be divided into three main streams:

1) The impact of increased chemical precipitation process-integrated technology to improve the balance of energy and reduction of greenhouse gas emissions from municipal sewage treatment plants;

2) Influence of surfactants on the effectiveness of the removal of wastewater pollutants in municipal sewage treatment plants;

3) Innovative methods of recovery of nitrogen and phosphorus from domestic sewage in areas with low intensity of usage.

Ad. 1.

Since 2013 interesting to me research topics I can develop by participating in a research team led by Assoc. Prof. Eng. Jack Mąkina program commenced in 2013 as a part of international research project *"Integrated technology for improved energy balance and Reduced greenhouse gas emissions at municipal wastewater treatment plants"* (BARITECH Pol-Nor / 197025/37/2013, 2013 - 2016) (est. 5, pos. 5). This project is co-funded by Norwegian funds, under the Polish-Norwegian Cooperation Research carried out by the National Centre for Research and Development. The aim of the project are the practical applications of sustainable sewage and sludge management in wastewater treatment plants, taking into account the technological and economic aspects, as well as the energy and greenhouse gas emissions. As part of the No. 1 assignment *"Increasing primary sludge production by coagulation and flocculation process in a primary clarifier"* of the above mentioned

project I'm doing research that involves the analysis of the effects of addition of organic polymers and coagulants to water treatment:

(a) the effectiveness of removing organic compounds from wastewater;

(b) the rate of biological processes in the biological part of municipal wastewater treatment plants;

(c) recovery of biologically easily degradable organic matter fraction from the initially generated sludge;

(d) the yield of biogas in an anaerobic digester based on the increased initial excess sludge.

Material consisted of samples of raw sewage and sludge, which was collected from two municipal wastewater treatment plants located in Gdańsk and Gdynia. The study used three commercial organic polymers and coagulant $ZnSO_4$ (as a point of reference). Experiments were performed with raw sewage sedimentation lasting two hours with and without the addition of the analyzed reagents. Studies were carried out on a laboratory scale in a specially constructed for the purpose of a laboratory apparatus for measuring the speed of the biochemical processes of sewage purification by activated sludge. The device consisted of two parallel reactors each electronically controlled not flowing thru unit with a capacity of 4 dm^3, remote control located in the controlling cabinet and computer. All controls and constant temperature was provided by water bath connected to the water jacket reactors. In addition, in the reactors were placed pH probe and redox potential probe, of which measurements were recorded in real time and archived in the computer memory. However, in the analyzed samples of waste water and sludge measurements have been made for concentration of fraction of organic matter, nitrogen and phosphorus. In order to determine the relationship between the increased production of pre used sludge and the production of methane, to calculate it we used the mathematical model - Anaerobic Digestion Model 1 (ADM1). At the beginning of 2015 it is planned to start these studies on a technical scale.

Based on the obtained results, it was found that the average removal efficiency of organic matter from raw sewage treated without the addition of a two-hour sedimentation reagents remained at 30%. However, after the addition of organic polymers to the wastewater, the efficiency has been significantly improved and nearly doubled. While coagulation with zinc sulfate caused a 77% reduction in the organic fraction and the colloidal suspension from the wastewater. The results obtained revealed that the tested organic polymers also contributed to the increased production of the initial deposit. The average volume of precipitate per liter of the treated wastewater is from 14.7 to 37.5 cm^3. Increased precipitation of organic compounds from wastewater using analyzed polymers did not affect the biological processes: the rate of release and collection of phosphates from wastewater (PRR/PUR) and the rate of collection of nitrate from wastewater (NUR). However, the removal of large quantities of organic matter present in the colloidal fraction and slurry after the

addition of zinc sulfate reduced the rate of biological processes for removing phosphate and nitrate from the waste water respectively by 30% in the conducted biphasic experiments and 20% during the one-phase experiments. Research carried out during mathematical simulations using ADM1 software allowed us to conclude that the initial chemical precipitation of organic compounds from raw sewage can help speed up and improve the process of anaerobic biogas production. Mathematical analysis showed that the use of organic polymers can contribute to increased efficiency of biogas production.

The study was presented at a science and technology seminar in Gdańsk (est. 6, pos. 27) and was met with great interest of the operators of sewage treatment plants and office representatives interested in the issue of environmental protection.

Positive opinion from the reviewers received submitted publication *"Effect of enhanced primary treatment on recovery of biodegradable COD from primary sludge and biological processes the activated sludge in the system"*, which will be presented at an international conference - IWA Nutrient Removal and Recovery 2015: moving innovation into practice, to be held next year in Gdańsk. Currently, there is a notification of a review of an article *"Effect of enhanced primary treatment on the production of biogas in wastewater treatment plants"* submitted for inclusion in an international conference - The 12th IWA Leading Edge Conference on Water and Wastewater Technologies, which will be held in 2015 in Hong Kong, China.

Ad. 2.

In cooperation with the Department of Chemistry and Industrial Commodity of Gdynia Maritime University and the municipal company - Water and Sewage Company in Swarzewo I took part in the implementation of research related to the evaluation of the impact of the presence of surfactants in wastewater on the effectiveness of removing contaminants in municipal wastewater treatment plants.

One of pollutants affecting the municipal wastewater along with the sewage are the surfactants. These compounds are widely used in various industries, such as the textile, paper, cosmetics and pharmaceuticals. They are also used in the production of food and fertilizers, paints and varnishes. Due to the widespread use of surfactants in detergents used in households, large quantities leak into the municipal wastewater treatment plants. Therefore, it seemed important to undertake studies that focused on the following issues:

a) the impact of the anionic surfactant LAS fraction on the mobility of phosphorus in the activated sludge in varying physico-chemical conditions;

b) to determine changes in the structure of activated sludge under the influence of surfactant.

Ad. 2a. The study was aimed to assess the type and part of the fraction of phosphorus in the sludge under variable environmental conditions. My task was to analyze the impact of the presence of anionic surfactant in the wastewater on its mobility. The analysis of quantitative ratios of phosphorus fractions provided important information on the sustainability of accumulation and the rate of release of this element from the activated sludge to the wastewater. The testing material consisted of samples of urban wastewater and activated sludge collected from the municipal sewage treatment plant in Swarzewo.

The work was carried out on a laboratory scale in a sequential biological reactor (SBR). Phosphorus speciation was performed for six series of measurements with different conditions in which the activated sludge was detained. For the three series the collected activated sludge was held under anaerobic conditions with the addition of a surfactant at concentrations of 10 and 100 mg/dm^3 and the sludge without surfactant. The next three series of studies were carried out in the aeration activated sludge with and without the addition of surfactant at the same concentrations.

The obtained results allowed us to conclude that in the analyzed sediments major role in the release of phosphorus into the liquid supernatant fractions served as the phosphorous organic matter and phosphorus associated with iron. Quantitative changes in the fractions of the activated sludge influenced the growth of the phosphate concentration in the effluent. In addition, during the phase when oxygen was present in the sediment the surfactant LAS hampered the accumulation phosphorus in it. This phenomenon has accelerated with increasing concentration of added surfactant. However, the ability of accumulate and store phosphorus compounds by bacteria in oxygenated activated sludge with the addition of the LAS was reduced compared with the sludge without surfactant.

Ad. 2b. In order to conduct the test the laser diffraction analyzer was used to determine the granulometric composition of the activated sludge in a biological treatment plant and to determine what changes happen to it under the influence of the presence of anionic surfactant in the wastewater. The tests were performed for different concentrations of SPC, both typical to occurring in municipal sewage as well as in industrial wastewater. To perform the analyses, samples were taken directly from the activated sludge aeration chamber. Background for the measurements was the oxygenated activated sludge. In each series of test samples of activated sludge concentrations of surfactant were added at: 10 mg/dm^3, 100 mg/dm^3 and 200 mg/dm^3. As an anionic surfactant, a linear sodium dodecylbenzene sulphonate (LAS) was added.

My task was to analyze the effect of the addition of surfactant to change floc size of the activated sludge. For the measurement of the size of flocs of the activated sludge I used a diffraction analyzer Mastersizer 2000 with the unit Hydro 2000MU, produced by Malvern Instruments Ltd. The

results obtained revealed that the dose of surfactant tested significantly affected the quality of the activated sludge. The presence of an anionic surfactant LAS helped to change the distribution of the floc sizes. The concentration of LAS surfactant below 200 mg/dm^3 in the settlement resulted in significant fragmentation of the flocs, but the higher the concentration resulted in their agglomeration. The largest and fastest changes in the fragmentation of the sludge floc sizes were observed upon addition of the surfactant at a concentration of 100 mg/dm^3.

The research results were presented at an international scientific conference (est. 6, pos. 25). The results of this collaboration are also papers published in national journals (est. 4, pos. B4-13, B6-29, B6-36).

Ad 3.

In Poland, approx. 40% of the population lives in rural areas. For smaller emitters of pollutants we are faced with a paradox - although individual emitters are small, but high total load of nutrients, coming from small emitters creates negative consequences for the environment. Although the amount of wastewater is reduced in rural areas compared with urban areas, they have higher concentrations of impurities. Currently, in rural areas in Poland there are only about 2,000 wastewater treatment plants with collective sewers that support 5% of the villages (approx. 20% of the population in rural areas). The main reason for such a small number of wastewater treatment plants is the spatial character of the development of the Polish countryside, which is clearly not conducive to the construction of area sewer systems. It is also estimated that out of a total of approx. 3 million farms as much as 75% of domestic waste is discarded without purification. The emerging need to rebuild the current way of thinking to reduce the pressure on the environment through the development of environmentally friendly practices needs to occur.

In order to improve at the same time the quality of life in conjunction and the environmental protection especially in rural areas I promote innovative management and recycling of domestic waste.

In recent years, I started cooperation with the Swedish groups related to the framework of International environmental Program EQUAL dealing with overall strategy of sustainable development and ecological sanitation. In particular it relates to the development of alternative treatment utilizing flushing bio-toilets by separating urine and treatment of other waste into compost. Properly separated urine allows reusing in natural circulation of at least 70% of the phosphorus and 50% of the nitrogen present in human excrements. With this technology utilizing separation toilets completely solves the problem of sewage and sludge management, while providing a natural use of the final products.

The whole experience gained during participation in the EQUAL Program I've entered into two monographs (est. 4, pos. B3-8 and B3-9), and numerous scientific and technical articles (est. 4, pos. B5-15, B6-18, B6-20, B6-21, B6-23, B6-30, B6-32, B6-34, B7-37, B7-38) published and reaching national and international audience. The work I presented the research results and practical guidance, supported by lessons learned from the analysis of the work of existing facilities. The work on this subject can serve prevalence among designers, installers and investors the information about alternative ways of development of domestic sewage in rural areas in Poland.

6. SUMMARY OF SCIENTIFIC ACHIEVEMENTS

6.1 BEFORE RECEIVING THE DOCTOR'S DEGREE

Before getting a doctoral degree in the years 2001 – 2005 I've published a total of 16 research papers. Among others, I was a co-author of two papers published in journals with IF (est. 4, pos. A1), two articles in the reviewed as collective works in a language with international reach (est. 4, pos. A4), four articles that became chapters in books with national reach (est. 4, pos. A5), two articles in peer-reviewed journals (including one in German) (annex 4, pos. A6) and five articles as part of conference materials (including two in a language with international reach) (est. 4, pos. A8).

In the years 2003 - 2005 I was the main contractor for the dissertation grant "Determination of the respiratory capacity of wetlands and deposits filters in domestic wastewater treatment plants during their operation" (est. 5, pos. 1).

I presented research results on twelve conferences (est. 6, pos. 1-12).

In addition, I was co-author of three expertise related to the possible application of the constructed wetlands method for wastewater treatment and disposal of municipal sewage sludge (est. 7, pos. 1-3).

In the years 2002 - 2005 I've attended eleven courses and internships abroad at the German scientific research centers and design and construction companies. Extremely valuable to me was a research stay in Germany under the DAAD (Deutsche Akademische Austauschdienst) grant which was a semi-annual scholarship (est. 8, pos. 1-11).

6.2. AFTER I RECEIVED MY DOCOTOR'S DEGREE

After obtaining a doctoral degree in the years 2006 - 2014 I've published a total of 45 scientific papers, including among others: six works in journals distinguished by the database of Journal Citation Reports (est. 4, pos. B1), three monographs and one research and didactic textbook on a national scale (est. 4, pos. B3), three articles which became chapters in books of international reach (est. 4, pos. B4), four articles which became chapters in books of a national reach (est. 4, pos. B5) nineteen works in peer-reviewed journals and other periodicals (including three articles in German, one in Russian and one in English) (est. 4, pos. B6) and six publications prepared for conference proceedings (including three in a language with international reach) (est. 4, pos. B8).

The above works were created within research projects. In the years 2009 - 2012 was a grant contractor and I managed two grants funded by the Ministry of Science and Higher Education (MNiSW) and by Regional Fund for Environmental Protection and Water Management in Gdańsk (WFOŚiGW) (est. 5, pos. 2-4). Currently I am taking part in scientific research project co-funded by the Norwegian funds, under the Polish-Norwegian cooperation Research carried out by the National Centre for Research and Development (est. 5, pos. 5).

I've participated in the execution of nine reports and expert opinions (including the one in Germany) thematically related to the protection of water and wastewater treatment (est. 7, pos. 4-12).

I made nine reviews for magazines of international reach (JCR) including for Desalination, Ecological Engineering, Environmental Technology, Journal of Environmental Management, African Journal of Biotechnology, Life Science Journal, and Environment Protection Engineering.

In the years 2006 - 2014 I've participated in the research internship in Portugal and held three specialized scientific courses in the country (est. 8, pos. 12-15). It was also extremely valuable for me to participate during this time in five international conferences and eleven national conferences and was able to make six lectures (papers) and two posters (est. 6, pos. 13 and 28).

Cognitive value and applications of my scientific work and research have been recognized by an award from the Rector of Gdańsk University of Technology for scientific achievements (est. 9, pos. 1).

6.3. STATISTIC INFORMATION

The total impact factor of all published scientific papers I (Impact Factor) in accordance with the list of the Journal Citation Reports (JCR) is IF = 13.753, including: IF = 11.694 for post-doctoral work published and IF = 10.932 for publications included in the cycle, forming monothematic scientific achievement.

The total value of the scoring of the Ministry of Science and Higher Education (PM), taking into account the percentage of the co-authors is PM = 212.55, including: PM = 190.1 for post-doctoral work published and PM = 93.2 for publication representing scientific achievement. The number of citations of scientific papers according to the Web of Science database is 37 and the Hirsch index of these publications is equal to 2.

7. INFORMATION ABOUT MY TEACHING ACTIVITIES

I began teaching while still a Doctoral Student at the Faculty of Civil and Environmental Engineering (WILiŚ) Gdańsk University of Technology (PG).

In the years 2005 - 2006 in the framework resulting from DAAD (Deutsche Akademische Austauschdienst) scholarship I've led a series of lectures in German and English on topics related to water treatment and sewage in the Department of Water Protection and Waste Management (Lehrstuhl für Wassergüte Laboratorien und Abfallwirtschaft) at the Technical University of Munich (Technische Universität in München).

In the years 2006 - 2008 I taught classes at the Faculty of Engineering, Architecture and Environmental Engineering, University of Technology and Life Sciences in Bydgoszcz (WBAiIŚ, UTP). Currently, I teach at the Faculty of Civil and Environmental Engineering, Gdańsk University of Technology (studies of I and II degree, full-time and part-time) and at the Engineering Department (WI) College of Environmental Management in Tuchola (WSZŚ in Tuchola) (bachelor degree, part-time).

Classes taught by me included the following subjects:

Lectures

· Water and Wastewater Technology (WI WSZŚ in Tuchola)

· Environmental Toxicology (WBAiIŚ UTP in Bydgoszcz)

· Fluid Mechanics (WI WSZŚ in Tuchola)

Auditorium exercises

· Water and Wastewater Technology (WI WSZŚ in Tuchola)

· General Chemistry (WILiŚ PG)

· Air Protection (WILiŚ PG)

· Construction Installations (WILiŚ PG)

· Fluid Mechanics (WI WSZŚ in Tuchola)

· Hydraulics (WBAiIŚ UTP in Bydgoszcz)

L**aboratory exercises (classes)**

· Water and Wastewater Technology (UTP WBAiIŚ in Bydgoszcz; WILiŚ PG, WI WSZŚ in Tuchola)

· General Chemistry (WILiŚ PG)

Project exercises (classes)

· Natural wastewater treatment methods (WILiŚ PG)

· waterworks (WILiŚ PG)

· Water and Wastewater Technology (WI WSZŚ in Tuchola)

Seminars

· Diploma Seminar (WI WSZŚ in Tuchola)

· Diploma Seminar (WILiŚ PG)

Developed original program schedule - classes and lectures on the subject of environmental toxicology. Also cooperated in developing exercise project oriented programs in two subjects: natural methods of wastewater treatment and air protection.

In 2012 a teaching manual "Sewer. Design, construction, operation" was released by Seidel-Przywecki, Warsaw based Publishing House, of which I am a co-author (est. 4, pos. B3-10). The book is the first on the Polish market this type of manual that in a compact form but presented in detail, among others, specific requirements of the new technical solutions - in the design, implementation and operation phases. Next to the dominant aspects of computing also other issues were raised such as the formal, legal and administrative aspects. It is worth noting that the overall existing literature is mainly from 40-50 years ago and basically relates to even older technology. This book is the first one that presents the commonly accepted standards of outdated sewer designs. To date, its customers - in addition to students and researchers - have become employees of many design offices and representatives of local and regional authorities (including the local government employees, municipal and the city offices). In 2013 I received the award for achieving the teaching excellence from the Rector of Gdańsk University of Technology for being co-author of this book (est. 9, pos. 3). In preparation is the second part of the book on the subject.

The first Master's degree has been completed under my supervision in 2006, since that time, I was a guardian of over 40 theses in this approx. 20 engineering works, repeatedly entrusted me with work reviews. Among others, the results of two of theses, first - associated with the recovery of nutrients from domestic sewage, the second - on ecological sanitation in areas with scattered buildings, carried out under my direction by post graduate students, Paulina Paszkiewicz and Dorota Woch and were published in 2013 and 2014 in the trade journal "Waterworks-Sewer "(est. 4, pos. B6-30, B6-32, B6-34).

In 2007 I was a tutor of full-time students majoring in architecture at the Faculty of Civil and Environmental Engineering of Gdańsk University of Technology.

Many times I was the organizer and guardian of student educational trips, both at home and abroad. Among others, Between 2003 and 2005, took care of a group of young scientists in the framework of the program "Young Scientists Programme" taking place on a regular basis, organized by the German side (ATV- DVWK, Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V.), which was carried out in Berlin (2003) and in Munich (2005) (est. 10, pos. 1 and 2). In 2014 I was a guardian to a group of students representing universities (Gdańsk University of Technology, Koszalin University of Technology, Cracow University of Technology and WSZŚ in Tuchola) involved in the research camp organized by the School of Environmental Management in Tuchola (est. 10, pos. 3). The purpose of the camp was to familiarize with the methodology of surveys and analyzes to develop a plan for environmental protection and pollution status of the selected villages. The task, with which the students were challenged during the visit, was to identify sources of emissions polluting the water, soil and air in Tleń (Kuyavian-Pomeranian province). The solution to that problem was presented by students under my direction at the Fifth International Conference on Science and Technology with its topic "Heating and ventilation in industry and agriculture" in 2014.

In addition, outside the universities, I've participated in training addressed to representatives of local governments in Poland (Gdańsk City Hall, Gdynia City Hall) and abroad (in Germany and Brazil), in cooperation with the Ministry of Environment in Bavaria, Germany (Bavarian Staatsministerium für Umwelt, Gesundheit und Verbraucherschutz) (est. 8).

8. INFORMATION IN A BUSINESS ORGANIZATION, AND COOPERATION IN SCIENCE POPULARIZATION OD SCIENCE

Since 2012 I am a member of the Consulting and Environmental Engineering Program at the School of Environmental Management in Tuchola.

In 2005 and 2014, together with a team from the Department of Water and Wastewater Technology and the Department of Sanitary Engineering Department of Civil and Environmental Engineering, Gdańsk University of Technology, took part in the organization of two international seminars and in 2009 in a national conference (est. 11, pos. 1, 2 and 5). Moreover, in the years 2013 - 2014 acted twice as scientific secretary of scientific conferences regularly organized by the School of Environmental Management in Tuchola (est. 11, pos. 3 and 7). Also as part of an ongoing Polish-Norwegian research project I've participated in the preparation of the two workshops that took place in Gdańsk and Poznań (est. 11, pos. 4 and 6).

As a manager and performer I've participated in two research projects funded by the Ministry of Science and Higher Education (MNiSW) and two funded by Regional Fund for Environmental Protection and Water Management in Gdańsk (WFOŚiGW) in Gdańsk (est. 5, pos. 1 - 4). Currently, I am the main coordinator of international research project under the Polish-Norwegian Research Cooperation (est. 5, pos. 5). Among others, from the funds gained from research projects measuring equipment for laboratories was purchased, i.e. in the muffle furnace, scale, Oxi-Top set oxygen measurements in the ground and thermostat cabinet. From the funds allocated from the Regional Fund for Environmental Protection and Water Management in Gdańsk laser granulometer manufactured by Malvern Instruments Ltd 2000 was purchased.

During my work and doctoral study I was making efforts with local governments in consulting and training on issues related to the protection and treatment of water and wastewater, and waste management. This activity was manifested through participation in seminars at home and abroad addressing the representatives of local governments. I've delivered lectures on the issues of determining the rates of demand for water and sanitary sewage emissions at meetings with representatives of local governments and companies involved in water and wastewater management (est. 8, pos. 5 and 15). I was also the author and co-author of a total of 12 reports and scientific expertise (est. 7).

I was expanding my professional skills (research, teaching) through participation in numerous courses, trainings, domestic and foreign internships (est. 8). Since 2002 I've participated in a total of fifteen internships and trainings, including twelve in foreign institutes (Technische Universität in München, Germany; Universidade da Beira Interior in Portugal; Wasserwirtschaftsamt in Hof, Germany; Bayerisches Staatsministerium für Umwelt, Gesundheit und Verbraucherschutz in Germany; Bayerisches Landesamt für Umwelt in Germany; Deutsches Bundesministerium für wirtschaftliche Zusammenarbeit in Germany, Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. in Germany; Fa. AKUT GmbH; Fa. Schlegel GmbH & Co.KG). At the invitation of the Bavarian State Ministry of the Environment (Bayerisches Staatsministerium für Umwelt, Gesundheit und Verbraucherschutz) I took twice part in seminars and projects devoted to Integriertes Wasser Ressource Management.

In recent years, I've made closer cooperation with the Swedish community, among others, being part of the EQUAL (Let us build together) program as part of an overall strategy of sustainable development and ecological sanitation. In particular it relates to the development of alternative treatment utilizing flushing bio-toilets by separating urine and treatment of other waste into compost. These systems are realistic solutions that meet modern targets of the EU Water Framework Directive and Sustainable Development. Therefore, in order to improve the quality of life in

conjunction with environmental protection especially in rural areas I promote innovative recycling of domestic waste. Also articles of which I am a co-author, may contribute to the prevalence among students, designers, installers and investors information about alternative ways of development of domestic sewage (est. 4, pos. B5-15, B6- 18, B6-20, B6-21, B6-23, B6-30, B6-32, B6-34, B7-37, B7-38). Cooperation with the Swedish side also resulted in the release of two monographs (est. 4, pos. B3-8 and B3-9).

In the framework of international cooperation I've participated in several international conferences. I also take an active part in national thematic conferences (est. 6). Papers presented at the conference have been published, among others, in the form of chapters in books and as articles reviewed in a collective work in the language of international reach as well as local (est. 6).

At the request of the editors of the international journals I've edited nine review articles, including twice for Ecological Engineering (IF = 3.479) and Environmental Technology (IF = 1.328); Desalination (IF = 3.481); Journal of Environmental Management (IF = 3.85); African Journal of Biotechnology (IF = 0.57); Life Science Journal (IF = 0.165); Environment Protection Engineering (0.434).

My activities for cooperation in science and popularization of science have been recognized with an award from the Rector of Gdańsk University of Technology for outstanding organizational work (est. 9, pos. 2).