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Białystok, on 29.05.2014

Summary of professional accomplishments

1. **Name and surname: Izabela Bartkowska**

2. **Diplomas, degrees - with the name, place and year of obtaining:**
   - MSc. Degree in environmental engineering, specialization in sanitary engineering, Institute of Civil Engineering, Bialystok University of Technology, 1983.
   - doctor of technical sciences in the discipline of environmental engineering, Faculty of Civil and Environmental Engineering, 1994. Doctoral dissertation entitled „The prediction of storm water pollution from urban catchment", promoter – professor, PhD, Eng. Andrzej Królikowski, Bialystok University of Technology.

3. **Information about employment in scientific/artistic units:**
   - 1.10.1983 – 30.09.1984 – research assistant, Institute of Civil and Environmental Engineering, Bialystok University of Technology,
   - 1.01.1984 – 30.09.1994 – assistant, Institute of Civil and Environmental Engineering, Bialystok University of Technology,
   - 1.10.1994 - to the present - assistant professor at the Department of Civil and Environmental Engineering, Bialystok University of Technology.

4. Indication of achievements resulting from Article 16 paragraph 2 of the Law on Academic Degrees and Title and Degrees and Title in the Arts (Journal of Laws No. 65, item 595, as amended):

A. author/-s, title/-s of the publication, year of issue, name of the publisher

A habilitation achievement, as determined in accordance with the applicable " Law on Academic Degrees... Article 16 paragraph 2" is a work published in full in the form of a habilitation monograph:
Isabella Bartkowska, Possibilities of using some technological parameters in the evaluation of the kinetics of autothermal thermophilic aerobic digestion of sludge, 2013, Bialystok University of Technology Publishing House, Scientific Dissertations No. 254.

B. discussion of the scientific/artistic goal of the aforementioned work/-s and the results achieved with the conclusions

Each process of sewage treatment is accompanied by the generation of waste. Depending on the size of the processes and the waste water treatment plant, primary sludge may be generated, excessive, following chemical precipitation and from an external organic carbon source necessary for the implementation of the steps associated with the removal of nitrogen (denitrification). We cannot prevent it from occurring as well as to reduce the amount, with the ever increasing demands on the quality of the treated wastewater. Therefore, there remains the problem of their development or final disposal.

The main directions of the disposal of sewage sludge include reducing its digestibility, eliminating pathogenic organisms, reducing the volume and mass of organic sludge, export from the area of treatment plants to their final use location. The process of sludge treatment must be safe for handling the plant and the surrounding environment. Environmental considerations militate in favor of the sludge, if possible, returning treated into the environment, providing soil with organic matter and nutrients to plants. This unconventional fertilizer is obtained as a result of autothermal thermophilic aerobic digestion (ATAD).

Technology of digestion in thermophilic conditions is still little known in the country, even though it was developed by Hubert L. Fuchs back in the 70's. Then, the first installation in Germany in Vilsbiburg was created, that has been operating to this day. Outside Western Europe such systems work in the U.S., Canada and Japan. Important role in the thermophilic digestion is played by microorganisms through which decomposition of organic compounds in sewage sludge is possible. It essentially runs in two stages. Hydrolysis of organic compounds (proteins, carbohydrates and fats) as well as decaying microorganisms' cell lysis in the first stage. These phenomena take place thanks to the participation of extracellular enzymes produced by thermophilic bacteria. In the second stage, oxidation by thermophilic microorganisms, hydrolysis products dissolved in the water, takes place to low energy compounds. These reactions are accompanied by the evolution of heat and end substances of these changes are CO_2, H_2O and NH_3. Delivering substrates of the appropriate concentration, with the supply of sufficient amounts of oxygen, in thermally insulated tanks, spontaneous heating of the sludge can be achieved to a temperature of 55 ÷ 80°C.

Thermophilic microbial organisms substituting crude residue being fed to the process, result in intense foaming. It is quite a homogeneous microflora, which comprised in more than 95% of the bacteria *Bacillus*, *Thermus* or *Actiomycestes*. Most of the strains belong to the species *Bacillus stearothermophilus*, which are active in the temperature range of 40 to 80^{o}C. The remaining microflora are thermo tolerant mesophilic bacteria and extremely thermophilic, among others, *Thermus*. Typically, they are characterized by their ability to multiply rapidly and the the thermophilic cell death proceeds equally rapidly as that occurs simultaneously with the process of autolysis. Their growth is not observed with a typical endogenous phase of respiration. In contrast, they very actively produce thermostable extracellular hydrolytic enzymes capable of rapidly and efficiently carrying out the hydrolysis of proteins, fats, carbohydrates, and other organic compounds as well as to lyse the dead cells of many microorganisms (e.g., pathogenic bacteria, yeasts or eggs of intestine parasites). Fatty acids derived from the hydrolysis products are the primary source of carbon and energy for thermophilic bacteria, and the amino acids are the main source of nitrogen. The bacteria are further characterized by high resistance to the products of metabolism and the ability to adapt to small amounts of oxygen. Very fast growth of thermophilic bacteria without proper seeding sludge with microflora, rapid biodegradability of the substrate, low sensitivity to temperature changes and resistance to periodic interruptions in aeration system, guarantee, even in emergency situations, extremely stable and flexible biological system in the environment of thermophilic digestion.

The thermophilic process is mostly carried out in tanks connected in series. The installation uses two or more tanks, usually cylindrical in shape, made of steel, concrete or plastic. In order to minimize heat loss reactors are thermally insulated and sealed. When tanks are connected in series, in the first installation stage, temperature in the lower range of thermophilic degradation is achieved and a maximum disinfection and the highest temperature in the last. Very rapid increase in the number of thermophilic bacteria without proper sludge microflora seeding, rapid biodegradation of the substrate, low sensitivity to temperature fluctuations and resistance to periodic breaks in the aeration system, guarantee, even in emergency situations, extremely stable and flexible biological system in the environment of thermophilic digestion. Daily discharge of neutralized sludge takes place only in the last stage. After completion of the next discharge raw sludge is fed to the first stage, while the partially processed sludge is moved to the next reactor. Movement of sludge from the first reactor into the next reactor causes only a modest drop in temperature. After feeding sludge, reactors are isolated for 23 hours, when the thermophilic decomposition takes place. In order to limit the temperature rise in the last reactor, a heat exchanger can be installed.

The lack of national experience in the field of knowledge of the application of ATAD was the basis to undertake research on its course. The opportunity to participate in the creation of installations from concept and design to system installation, commissioning and operation of technology has enabled to gain extensive experience. The main purpose of the tests undertaken, apart from complementing the knowledge of the process, was to examine its effectiveness in terms of stability and hygenisation and thus indicating the direction of a significant disposal of sewage sludge in sewage treatment plants with a capacity of up to 20,000 m^3/d. The scientific purpose was to document the kinetics of the process, being conducted in a two-stage installation, with selected technological parameters. A utilitarian goal was also significant that, by using appropriate analytical tools, enables the use of the obtained relationships of the design and operation of other objects also in new areas of application.

The purpose of the research was also to design, build and implement ATAD systems in the sewage treatment plants in Giżycko, Lubań and Olecko. The first stage of the research was performed at the time of installation start-up and the initial period of operation. The priority objective of this study was to document the effectiveness of the process in terms of hygenisation and digestion of sewage sludge. Sludge temperature changes during the process and the decrease in the dry matter content were primarily analyzed. Statistical analysis of test results and mean value tests confirmed the raised hypothesis. Detailed results of the start-up period were presented by Bartkowska (2005) and later by Bartkowska and others (2005) and Bartkowska and Dzienis (2007). The results were of decisive importance, as an ATAD installation was established in 2003 in Giżycko to be the first of its kind in Poland. Analyses of changes in temperature, dry matter content and dry organic matter were also made during the start-up and initial operation of the ATAD installation in Lubań in the years 2006-2008. Effects obtained in Giżycko were confirmed and detailed results were presented by Bartkowska and Dzienis (2009). Research conducted in Lubań was extended by measuring the pH of sludge before and after ATAD. Results were presented by Bartkowska (2011).

Another facility included in the research in 2009 was the sewage treatment plant in Olecko. The second stage of the research was extended to the measurement of COD, conductivity and the oxidation-reduction potential of sediments. Tests were performed in two series. Detailed results of pH changes in the sludge in the ATAD process in a three-stage installation were presented by Bartkowska (2014). After the first series of studies, analysis of the results of measuring the redox potential on the example of a two-stage installation in Olecko was also presented by Bartkowska (2014). From this period two new publications have been prepared. One of them shows the change in conductivity of the sludge. In the other, changes of dry matter, organic matter in the sludge dry matter and COD values were analyzed. Both during the procedures of publishing.

The sewage treatment plant in Giżycko obtained an authorization to market a sewage sludge fertilizer, as mentioned by Bartkowska and Wawrentowicz (2011). In contrast, the treatment plant in Olecko obtained an authorization to market a soil improver. The results of this procedure are shown by Bartkowska (2013).

The monograph compiles all of the results of research conducted in three sewage treatment plants, including recent not yet published results of the second series. Each tested technological parameter was analyzed separately, showing changes during the process, in the reactors of each installation. The results are shown based on the methods of descriptive statistics, regression analysis, correlation and test statistics.

One of the parameters analyzed was sludge temperature, which is particularly important given that it demonstrates both the extending process being proper and uniform, proper operation of aeration devices. Sludge temperature resulting from the taking place biochemical processes is also a determinant of their hygienisation. Total mean temperature increase was from 32 to 42^{o}C. Larger temperature increase was observed in the first stage of the installation in Lubań and Olecko. In Giżycko, greater temperature increase occurred in the second stage of the installation. A probable cause was the result of the composition of the sludge supplied to the system. All the tested plants are mainly fed with excess sludge. However, in Giżycko they are fed from active sludge chambers and secondary sludge tanks. Taking into consideration the obtained temperature and hydraulic retention time of sludge in the system it must be concluded that the tested technology fulfills the conditions necessary for effective hygenisation. This is also confirmed by repeatedly performed microbiological and parasitological studies which did not show the presence of Salmonella and live eggs of intestinal parasites *Ascaris sp., Trichuris sp.* and *Toxocara sp.*.

As a criterion for sludge digestion a decrease in organic matter content is frequently indicated, which should be 38%. In the wastewater treatment plant in Lubań more than 50% of the calculated reduction in organic matter content reached a value indicated in the treatment plant in Olecko. This result was achieved in 53%. It should be stressed that the process was carried out in real conditions on a large scale. Also, a decrease in organic material, expressed in COD values of more than 95% of the results ranged from 21.56% to 71.56%.

It seems important to be making a presentation of the ranges of values of conductivity and redox potential. During the process of autothermal thermophilic aerobic digestion of sludge a several or a dozen times increase in the proper electrolytic conductivity was noted, which depends primarily on the type and amount of solutes dissociated of inorganic nature. Such measurements are commonly used to study the degree of mineralization of the total water or soil. The continuous measurement of conductivity in the reactors allows to control changes. The measurement of the redox potential may be useful to monitor biochemical changes direction. Its average value in concentrated sludge was -225.16 mV, in the sludge from the first stage reactor -369.43 mV and in the stabilized sludge -442.32 mV. Measurements of conductivity and potential were performed in both parts of the research, but at only one facility. The final decision of the on-line measurement of both parameters should be preceded by further research on another facility. The more that literature contains little information concerning the measurement of conductivity and redox potential during this process.

The study showed that a much larger decrease or increase of the analyzed parameters take place in the first stage reactor, where all biochemical processes are much more intense. This speaks for the need to consider the possibility of increasing the capacity of the first stage reactor and the amount of air supplied. This would ensure the intensification of processes in the tank. This would enable to provide the necessary oxygen for the moment when it is most needed. Increasing the capacity of the tank will improve the energy balance of the whole process and the heat balance. Intense formation of odors would also be limited primarily to the reactor. While, the second stage of the installation process will take over mostly hygenisation. Completion of the course of most biochemical processes in the first tank can also improve the ability of the obtained sludge drainage.

While analyzing the results of the condensed sludge prior to ATAD and from the subsequent installation stages a clear trend of change was noted. A significant achievement is the presentation of the nature of these changes during ATAD conducted in a two-stage system. Their approximate course is depicted in the charts. The lines illustrate the trends whose alignment was obtained by the distance-weighted least squares method. Smoothing was used to extract the trend of the studied phenomenon as well as the elimination of fluctuations, which could be the result of random errors or performance. Basing on the created charts assessment of the two-stage ATAD installation is possible. Analyzing one of the abovementioned indicators of pollution on the basis of the result in the condensed sludge, with some approximation, the course of changes can be presented. The observed trends will help create further nomograms at different initial values of the indicator. Charts prepared in this way will thus facilitate the operation in similar installations.

Each process of disposal of sewage sludge should lead primarily to their stability and hygenisation and cause a decrease in their amount. The whole discharge-feed process is automatically adjusted in accordance with the planned ATAD installation capacity. If necessary it is possible to manually operate discharge and supply the required amounts of sludge, for instance depending on their instantaneous needs of production and treatment. Therefore, the amount of sludge processed to some extent depends on the exploiter. However, balancing the amount of sludge fed and received after a certain period of time can assess the degree of reduction. Very promising results were obtained during the period under study in the case of the treatment plant in Lubań. Reducing the amount of sludge in the process was at work of the two-stage ATAD system 79.6 %, when operating in a three-stage system 79.11 %. This significant decrease in the amount of sludge appears to be likely, as thermophilic microorganisms require more energy to maintain their life processes than mesophilic microorganisms. From the total amount of energy, resulting in the thermophilic oxidation of organic compounds the greater part is used in the metabolic transformation of microorganisms, while less to produce new cells. Thus, the processes taking place at elevated temperature are characterized by a relatively low biomass production as compared to mesophilic processes.

Many years of observation, experience gained and the analysis of the gathered material allowed to draw the following conclusions:

1. ATSO implemented in the studied systems allows sewage sludge to be gigested and hygenised.

2. Physico-chemical properties of the processed sludge indicating the benefits of the possibility of their use in nature also appear to be compelling.
3. Autothermal thermophilic aerobic digestion of sludge can significantly reduce their amount.
4. When designing and implementing new investments, one should consider the possibility of increasing the capacity of the reactor constituting the first stage of the installation.
5. Continuous measurement of redox potential in the reactor of the first stage can be used as an effective tool in the diagnosis process while measuring the proper electrolytic conductivity should apply to the last stage of installation.

ATAD runs in the described systems in a fully automated manner. This does not mean, however, that it is impossible to improve the efficiency of its operation. Documented research and their resulting conclusions indicate the direction to take modernization of operating installations. Due to the expected effects in the energy balance, one should use the comments made in the design of subsequent installations. It seems important primarily at increasing the volume of the first stage reactor. The analysis of the collected material can suggest the use of the capacity by 20 to 25% higher compared with the capacity of the second stage reactor. With the increase in the volume, the intensity of the aeration reactor is to be increased. The positive effect of such changes can also be the reduced amount of odor. It is also advisable to continue further studies aimed at obtaining tangible benefits in the implementation process, which seems to be an effective method of final disposal of sewage sludge. In particular, further research on continuous measurements of redox potential, which will allow to assess the direction of biochemical reactions, and proper conductivity, through which one could assess the degree of mineralization of sludge being handled with ATAD. Both indicators could to help in assessing the degree of sludge stabilization, which is an important criterion for their final use.

5. Discussion of other scientific and research achievements

My research scientific and research achievements are closely linked to employment in the Bialystok Technical University and pursued professional work. It is difficult to isolate the time periods in which I was committing itself to specific interests and closing them only at certain times. Their implementation was often running simultaneously or overlapping each other. Certainly can, however, the main topics of my interests' focus can be specified.

The most important include:

- storm water quality and methods of treatment before discharge to the receiver,
- purification of domestic wastewater, in particular the use of sequential bioreactors,
- disposal of sewage sludge, mainly using ATAD,
- application of photocatalytic oxidation and ionized active oxygen in the air deodorization at sewage treatment plants,
- solving decision problems using a multi-criteria analysis.

A pilot study was conducted in rainwater sewage in the period 1985-1987 executed at different catchment areas within the city of Bialystok, Elk and Gołdapia. The second stage of the study concerned the catchment area selected in Bialystok and too place in 1992-1993. The results are shown by Bartkowska and Królikowski (1996). Subsequent studies included a qualitative analysis of rainwater, wastewater and meltwater. Their reaction was determined, the content of suspended solids, COD and BOD5 values, the concentrations of nitrogen, phosphorus, chloride, sulphate, dissolved substances and electrical conductivity. At the same time qualitative research was carried out with detailed observations and measurements of the amount of rainfall using a pluviograph. Results and analysis were presented in the doctoral thesis entitled "The prediction of storm water pollution from urban catchment".

The experience gained in this field had been used for the implementation of further research. The first entitled "The storm water treatment for the city of Bialystok. Neutralization of rain water from the city of Bialystok" was implemented in 1994-1998. The second entitled "Protection of surface waters of the Augustów Lake area against point, linear and spatial pollution" was performed in 1998-2000. The results presented by Bartkowska (1997 and 1998).

Another of my interests focused around issues related to the operation of sewage treatment plants. The first results on this topic were presented by Bartkowska and Dzienis (1995 and 1996). In 1998, a study was started on the BIOGEST BSK waste water treatment technology, based on the low-pressure activated-sludge method, implemented in a sequential biological reactor with continuous inlet with mechanical aeration. These wastewater treatment plants were located mainly in the north-eastern part of the country. The experience gained was primarily utilitarian in nature. It has been published and presented in the form of papers by Bartkowska and Dzienis (1998, 2001, 2004) and Bartkowska and others (2002). Later, another study was presented by Bartkowska and others (2011), Bartkowska and Wawerentowicz (2012) and Bartkowska and Klaus (2013).

While conducting research in wastewater treatment plants it was impossible not to notice the sludge economy problems growing during this period. The search for new solutions in this field led to the presentation in 1999 of the process of autothermal thermophilic aerobic digestion of sewage sludge in the "Concept of the modernization of the wastewater treatment plant in Giżycko". This process was also presented in conference materials by Bartkowska and others (1999). Then a project was created, and after its implementation research began on the effectiveness of this process in the national context. Since 2003, studies are carried on sludge undergoing ATAD. The result were subsequent installations in Lubań (2006) and Olecko (2009). Results were successively published and presented in the form of papers, among others, by Bartkowska and others (2005), Bartkowska and Dzienis (2006) Dzienis and others (2006) and Augustin and others (2007). Overall results of the research, including the unpublished, from the first three facilities in Poland are presented in a monograph. Research is still being continued in the newly established plants in Pisz, Kętrzyn and Oława. The installations' start-up took place in 2012. Last installation began operating in 2013 in a sewage treatment plant in Dąbrowa Białostocka. The last project was made in accordance with the suggestions, as a two-stage installation with the increased capacity of the first stage reactor.

Side effects of the thermophilic digestion of sludge are strongly foaming sludge and odor nuisance. The air discharged from the thermophilic digestion chambers contain compounds that include the onerous odor. These are mainly ammonia and products of incomplete oxidation and decomposition of organic matter. Ammonia is produced by ammonification proteins, and is the main culprit of odor nuisance. In addition to the presence of ammonia reduced sulfur compounds can be noted (e.g., hydrogen sulfide, mercaptans, dimethyl sulphide), aldehydes, ketones, volatile fatty acids, and other thioalcohols. The formation of odorous compounds is favored by oxygen deficit caused by the high temperature of the process and the associated low redox potential. The first experience with the operation of biofilters in Giżycko has unfortunately not been satisfactory. Looking for a new process for the purification of exhaust gases from ATAD installations has been started, that could be used in other facilities for air deodorization. A photocatalytic oxidation device has proven to be an excellent solution. The photocatalytic process of oxidation (PCO) is based on two-stage flue gas treatment based on the use of ultraviolet light, and a catalytic converter just behind. Gases mechanically pre-cleaned off dust are directed to the ionization chamber, where oxygen radicals are then generated by the UV rays along with hydroxyl radicals, as well as pollutants' radicals with the formation of ozone from the oxygen contained therein. The source of irradiation are lamps of a special design. Radicals, always much more reactive than the untreated molecules, immediately initiate oxidation in the presence of available oxidants. Complete oxidation of the pollutants contained in the waste gases, however, requires a sufficient contact with responsive particles. The catalytic converter, with its large surface, provides precise distribution of pollutants and at the same time is a buffer for peak loads. It also allows the ultimate oxidation of the decomposition products by adsorption on its surface, without absorption, and prevents the release of ozone into the environment. Physico-chemical reactions occurring during the process of PCO are very complex. Strong oxidizing agents, such as ozone or hydroxyl radicals, are used for the decomposition of odor-producing substances. For example, hydrogen sulfide (H_2S), one of the most famous odor-producing substance, is decomposed as a result of the so-called Klaus reaction. In the ionization chamber, in the presence of oxygen, it oxidizes and sulfur dioxide is formed. In turn, the sulfur dioxide in the presence of a catalytic converter reacts with hydrogen sulfide and sulfur and water are formed. Other degradation products are mainly carbon dioxide (CO_2) and water (H_2O). Results of preliminary tests were presented by Bartkowska and Dzienis (2004 and 2006), Augustin and others (2007) and Bartkowska and Wawrentowicz (2014). Interest, as well as research, has been extended to the next process, which uses the phenomenon of air ionization. Ionizing lamps in devices produce strong electrostatic field. Between two electrodes of ionizing lamps corona discharges occur, launching chemical reactions. The result of these reactions is, on the one hand, the passage of the primary electron orbit to the orbit of higher potential energy, while on the other hand - the actual production of oxygen ions. Both mechanisms occur at the same time in the device: the activation of oxygen and ionization. The produced highly reactive oxygen is a strong oxidizing agent. As compared to the neutral active oxygen additive it has a high possibility of oxidation and thus allows fast oxidizing and neutralizing even strong air pollutants. Oxidation of the impurities takes place to such final products as water, carbon dioxide and other harmless compounds. The second effect is the polarization of the oxygen and other air molecules due to the strong electrostatic field. Active oxygen and polarized or charged molecules settle on the particles as dust. Therefore, reactive aggregates are formed, which are blown out of the active oxygen installation into the room. In addition, further reactions occur resulting in the purification of the air. Microorganisms associated with clusters immediately lose their activity. Cleaned and refreshed air is sucked back into the room. Both processes, PCO and IAO, are ideal for deodorizing sewage treatment plant facilities. The existing installations are included in successive tests.

Scientists, policy makers, engineers every day face the need to make decisions that affect the planned projects and their modernization. That can be based on technical and non-technical as well as measurable and non-measurable criteria that are often contradictory and cannot be simultaneously met in an optimal manner. The criterion frequently taken into account is economy. The practice of decision-making is focused on weighing the opportunities that satisfy a set of desired goals. Decisions are to select one of the options. Each decision problem includes at least one optimal decision in respect of which you can objectively determine that there is no other, better decision while maintaining neutrality in the decision-taking process. The problem is the choice of this option that best meets the complete set of objectives. These dilemmas have become the basis for the search for new areas of interest. Great opportunities in this field are provided by the multi-criteria analysis, the application of which in the field of environmental engineering systems has become a cause of attempts to explore this area of knowledge. Multi-criteria analysis is in fact a mathematical method, allowing you to choose the best solution. Dynamic development of methods and computer techniques contributes significantly to the increase in the possibility of using both the decision analysis purposes and cognitive application. The broad spectrum of its practical applications leaves no doubt as to the necessity of deepening the scientific discipline. Especially in environmental engineering, there is still a need to develop an interdisciplinary approach that will combine behavioral and quantitative aspects of the theory in a consistent process useful for both theorists and practitioners. The first trials were presented in two publications by Nytko and Bartkowska (2013). They exemplify the use of multi-criteria analysis in the selection of variants of technological operation of wastewater treatment plants in areas with defined requirements of the ecological status or ecological potential of surface waters.

A quest to take the key theme, process modeling, has become an inevitable consequence of the ongoing research and interests. According to the latest global trends, mathematical modeling is becoming an integral part of the design and operation of wastewater treatment and disposal of sewage, especially based on the activated sludge process. Simulation of activated sludge systems turns out to be an extremely useful tool for exploitation, designers and consultants, as well as for the scientific community. The time and cost effects of experiments conducted on a large scale for the different system installation and operating conditions render such a costly and lengthy research in the context of the preparation of the design process and operational management. Laboratory scale experiments provide understanding (to varying degrees) of the plurality of microbiological and chemical processes associated with it but the results are not always sufficient. The use of mathematical models allows you to examine, in a short time and at low expense, many technological solutions and simulations of events outside the range of conditions typical for the real system. By collecting research results, we provide tools which will allow to obtain the necessary information about the design process based on computer simulation.

ATAD uses the process of bacteria growth to reduce both organic substances and for the destruction of pathogenic microorganisms. Aerating sludge supports the development of aerobic bacteria that reduce available organic compounds. Such metabolic activity produces energy and raises the temperature of the sludge. Thermophilic bacteria in a colony thrive at high temperatures. In contrast, the majority of pathogenic organisms are mesophiles, the metabolic activity of them decreases rapidly at temperatures above 40-45°C, they dye due to a sufficiently long temperature exposure. Aerobic, thermophilic bacteria multiply and dominate the hot sludge, and ATAD uses their metabolic activity to produce heat which achieves the hygienization and reduction of organic substances. This simplification of the process, accumulated research results and knowledge gained let us move to the next objective, optimizing ATAD systems. Efforts have been associated with the development of a simplified model of the process. The model will be based on the existing ASM1 model, which, according to microbiologists, includes the necessary processes needed for ATAD modeling. Calibrating the model, defining the unit processes and describing them using equations, determining the type of substrates subject to change, describing and taking into account other factors influencing its course will lead to a further modification which will show the complexity of the real process. So far, research carried out enabled the first steps in this new challenge, also paving the path to the next interests.

Izabela Bartkowska

signature of the applicant