For a Clean Environment

We discuss waste, fuels, and air quality with **Prof. Czesława Rosik-Dulewska** from the PAS Institute of Environmental Engineering and the Department of Land Protection at the University of Opole.

ACADEMIA: **Your areas of expertise, including engineering and environmental protection, soil protection and waste management, are already crucial, and in time will be even more important to our functioning on earth. Do these areas attract many female students?**
CZESŁAWA ROSIK-DULEWSKA: A few years ago they attracted quite a lot of them. Currently, there are far fewer women studying these subjects, not only due to population decline, but also because of job saturation.

Women make up only a few percent of all technology students. Are they treated on par with their male colleagues, and do they have equal opportunities in finding a job after graduating?
A lot is changing in this area as well. There are plenty of female students not only in our areas, but majoring in other technical subjects as well, and their chances on the job market are the same as those of their male colleagues. The assessment of the state of the discipline made by the PAS Environmental Engineering Committee (2011 edition), on the percentage of women among all environmental engineering researchers at institutions and universities, showed a significant increase at polytechnic universities, up from 21% in 1997 to 38% in 2007, but only a slight increase at natural science universities, the Polish Academy of Sciences and at research institutes.

Does Poland emit a lot of greenhouse gases compared to other European countries?
Carbon dioxide is the main source of our domestic emissions – 81.65%. Methane and nitrous oxide emissions are much lower, currently amounting to 10.9% and 5.2%, respectively. Since 2008, emissions have been stable, and since 2010 greenhouse gas emissions in Poland have been gradually decreasing. Over 22 years, Poland has managed to reduce emissions by about 14.0%. We are still far from joining the ranks of European leaders in this regard but, considering the fact that Polish energy is coal-based, these numbers are not bad.

One of the areas you deal with is choosing waste recycling and disposal processes based on their physical and chemical properties. Scandinavia is the European leader when it comes to recycling. What is the current state of municipal waste management in Poland?
According to the Central Statistical Office, Poland produces around 10–12 million Mg of municipal waste annually, that is about 300 kg per year per capita, which is one of the lowest rates in the European Union. Municipal waste management should primarily be based on selective collection, as only selectively collected waste is suitable for recycling. This process and, to a lesser extent, waste sorting can ensure that we will meet the requirement of reusing and recycling 50% of paper, glass, plastics and metals by 2020. Since 1 July of this year, recycling also includes biodegradable waste, which is a green light for the closed circuit of organic matter. Unfortunately, in 2015, we collected only about 6% of it. For example, in 2015, we collected 10.86 million Mg of municipal waste, of which about 27% was recycled, about 16% composted, around 13% thermally processed, and approx. 44% stored.

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What modern technologies are used today in natural waste management, and do we use them in our country?
In natural waste management, organic waste is extremely important. Closing the circuit of organic matter in nature is one of the fundamental aspects of a closed circuit economy. Under EU regulations, by 2020 Poland is required to reduce the amount of biodegradable waste deposited on landfills in relation to the mass produced in 1995 by 65%. We know that it is mainly this fraction that is responsible for the emission of methane and carbon dioxide, or the greenhouse gases, from landfills. In my research on selecting processes and technologies for natural waste recovery/disposal, I was able to show that applying innovative research, using sequential chemical extraction analysis for the purpose of identifying the chemical composition of waste, allowed us to correctly determine the effects of the applied technologies in municipal sewage sludge and waste composts, and indicate potential risks when introducing them to the environment. Using these research results, I also developed the technological concept for producing organic and mineral fertilizers from municipal sewage sludge stabilized with fly ash from lignite and hard coal, which meet all environmental protection requirements. In addition to organic waste, we also have a lot of mineral waste with beneficial mineralogical and petrographic composition, as well as good chemical properties that can be used in nature, such as the agromelioration of poor quality soils, increasing their productivity. In addition, both organic and mineral waste (such as power-industry ashes) have the ability to absorb pollutants, which limits their transfer to the food chain. Calcium and magnesium fertilizers can be created from fly ashes. However, mineral waste is still used mainly for environmental engineering works and in construction.

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What is thermal waste processing, and is it the best way of dealing with waste?
To answer that question, I should include this process in the concept of recycling. These days thermal waste processing, including through incineration, is an important part of the municipal waste management system, especially in cities with fewer than 300,000 residents. However, it cannot dominate the entire waste management process, because recycling, based on selective collection, is a priority. After 2025, the plans are to recycle 50% of certain fractions of municipal waste, up to 30% through thermal processing, and 20% through biological processes.

How many municipal waste incineration plants do we have in Poland, and is it a sufficient number?
At this time there are 7 incineration plants for municipal waste in Poland. They are located in Warsaw, Bydgoszcz, Konin, Kraków, Poznań and Szczecin, processing about 1 million Mg of waste per year, or about 10% of the total, which will bring us only a bit closer to the more developed EU countries where the amounts of incinerated waste are from 20% (Great Britain, Italy, Portugal) to over 50% in Denmark and Sweden. From the amount of waste and the expected ways of their processing we can estimate that we should build another 3–4 mixed municipal waste incineration plants and approx. 8–12 refuse-derived fuel (RDF) incineration plants.

Can energy from thermal waste processing be a renewable energy source?
The ordinance of the Minister of the Environment (2016) on the *technical conditions for the qualification of parts of energy recovered from the thermal conversion of waste* determines how much of the energy produced in the aforementioned installations can be treated as RES. For example, the flat-rate amount of energy included in RES for thermally processed municipal waste is 0.42, while for municipal sewage sludge and six types of wood waste it is 0.90. So it is worth it!

How are solid recovered fuels used for the production of electricity and heat in Poland today?
The development of technologies for producing alternative fuel from municipal waste is one of the significant challenges facing waste management. The operating data of the MBP installation show that about 30–40% of refuse derived fuel (RDF) can be obtained from processed waste, which means that it will amount to approx. 3–4 million Mg a year with a calorific value of 13–18 MJ/kg. Currently, the cement industry in Poland obtains approx. 55% of the heat energy needed for clinker production (max 80–90%) from the incineration of alternative fuels, which is more than the European average.

Are we using pyrolysis for the recovery and disposal of industrial and municipal waste?
I cannot cite a single example of using this process on an industrial scale for municipal waste in Poland. Obtaining an energy efficiency index below 0.65 in this process (a requirement to qualify for recovery) is impossible. Our incinerators can easily obtain a recovery status. The first gasification installation (I am a member of the Consultative Committee) designed for pre-RDF together with municipal sewage sludge will be launched as part of the Life Cogeneration P1 program financed by the EU, NFOŚiGW (the National Fund for Environmental Protection and Water Management), and the private investor Investeko. We do, however, use pyrolysis technologies for selected industrial waste, including hazardous waste, but recovery is not a given in this case.

In the UK every household receives a container for organic waste, which then serves as compost. When will this happen in Poland?
Many communes have previously collected organic waste in this way, and since 1 July 2017, the Ordinance of the Minister of the Environment entered into force (December 2016) with particular emphasis on obtaining bio-fractions, which should be composted or subjected to methane fermentation. Currently Poland has over 200 composting plants and several installations for the methane fermentation of waste.

We have been recycling containers for over 20 years. The first bins for collecting paper, plastic and metal containers appeared in Poland in the 1990s. Is the awareness of the need to recycle growing among Poles? Do we sufficiently understand the necessity to recover secondary raw materials?
Unfortunately public awareness is growing at a slow pace, often forced by imposed orders or bans. We currently have 2 regulations in this area that we must follow. There is no returning to old bad habits.

In your opinion, what are the biggest challenges that may soon be facing environmental engineering in Poland?
We know that environmental pollution can directly lead to changes in air and water quality, soil degradation, changes in the terrain and landscape, or depleted biodiversity, as well as indirectly lead to economic and social losses. The most serious effects of environmental pollution that we are currently experiencing include the greenhouse effect, the hole in the ozone layer, acidification and smog. Therefore, the preventive and protective measures that we must take include limiting energy and material consumption, industrial and municipal risks, and changes in the development of communication infrastructure and spatial policy. In analyzing individual elements of the environment, I believe that the challenges for water management include protecting waters against pollution and their improper/excessive exploitation, improving their cleanliness, ensuring adequate quantities and quality of water for humans, industry and agriculture, protection against flooding and droughts, regulating the water balance, creating the right conditions for using water resources for energy, fishing and transport, as well as meeting the needs of tourism, sports and recreation.

In terms of air protection, it will be important to adhere to the requirements of the Industrial Emissions Directive (IED), which means tightening the requirements for emission standards from combustion plants, restructuring the thermal energy production potential, as well as adapting industrial installations to the BAT requirements. It is also important to follow the EU climate policy provisions covering emission trading in relation to the development of the energy sector. The key here will be the action plan for a low-emission economy and meeting EU environmental protection requirements until 2020, namely reducing greenhouse gas emissions by 20%, and increasing energy efficiency by 20%, the amount of biofuels in transport fuels by 10% and RES up to 20%.

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Protecting and improving soil quality will require limiting the allocation of biologically active soils for non-agricultural and non-forestry purposes, protecting those which are highly ecological and productive, preventing their chemical degradation, limiting water and wind erosion, and preventing over drying, waterlogging and technical degradation. In the area of waste management we must try to prevent its occurrence, support recycling, and if necessary dispose of it, including through safe, minimal storage. The challenges for wastewater management include continued sanitation of the country, introduction of modern technologies for wastewater treatment, which require reducing BZT5 to 98.3%, N to 89.9%, and P to 93.5% According to the 2016 Central Statistical Office data, 93.9% of urban and 37.4% of suburban residents use treatment plants in Polish agglomerations.

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