Social Significance of Technical Water Purification and Treatment Plants – on the Cusp of New Functions of the technical Service Buildings of Cities

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Abstract. Departure from environmentally unfriendly public attitudes and the increasing awareness of environmental protection and the management of natural resources among the residents of cities lead to pro-environmental design efforts—including planning and urban-design-related ones, for the shaping of urban structures. One of the elements of cities that, on the one hand, stir public emotions and on the other constitute an inseparable element of the urban organism, are structures that provide technical services to cities. Examples of these structures include wastewater treatment and water purification plants. The goal of this article is an attempt at finding an answer to the question about what role do wastewater treatment and water purification plants currently play in the structure of Polish cities and what other roles can they play. Particular emphasis was placed on the public reception of such structures. Based on Polish cases, this reception appears to most often be either neutral or negative. The author explores the mechanism of these reactions and their causes, particularly in reference to other structures that provide technical services to cities (e.g. eco-incineration plants, whose construction is faced with intense opposition from residents in Polish conditions almost every time). The author searches for an answer to the question about the cause of public opposition to the construction of these types of structures, and whether we can—and if so, then how—prevent such public attitudes in relation to these types of structures.

1. Introduction

The raised awareness of residents in the context of a eco-friendlier life can be referred to in terms of direct individual actions (waste segregation, deliberate use of running water meant to reduce its consumption, using multiple-use packaging etc.), which alter everyday habits, as well as in terms of ecology in general. This approach, which is becoming more and more widespread every day, is reflected on a broader scale—in city governance in accordance with the concept of sustainable development, including, among others, the appropriate use of natural resources [8], care for clean air [2], waste management [1, 7, 11] or the correlation of municipal activities in such a manner so that they can be considered a policy of an eco-friendly city (eco-friendly society) [5] and contemporary concepts of city development [6]. A departure from the current model of resource consumption both in the perspective of the actions of municipal authorities and in the individual approach of residents, has an impact on perceiving the city as a whole in a new manner, including in the sphere of its engineering infrastructure.
Structures that have so far been treated as a sort of "necessary evil", decreasing the attractiveness of given locations and fulfilling solely technical functions, can become elements that are spatially attractive. This attractiveness can be understood not only in the visual sense, but the functional one as well, which can have a direct impact on the social sphere of the functioning of urban centres or suburbs. Examples of structures that provide such opportunities include new projects featuring elements of municipal engineering infrastructure, which, thanks to the introduction of new technological solutions, have had their negative impact severely reduced or eliminated almost entirely. Technological changes have also created the possibility of opening these structures to a greater extent in order to, for instance, facilitate pro-environmental education or other associated public initiatives. A different outlook on the function of such structures is also reflected in design proposals in which new technical solutions as well as structural and material possibilities cause buildings of this type to be able to become attractive elements of urban tissue—including in visual terms. In Western European countries we have already been able to observe the first examples of such solutions for several decades [10]. At present, examples of good practice primarily refer to thermal waste processing plants, however, attempts at semantically introducing wastewater treatment and purification plants into urban structures (in an architectural and spatial sense) have been made as well [9]. The examples mentioned above refer to projects located in Poland to only a negligible degree and if they do, then these are only thermal waste processing plants. Compared to, for instance, Western European countries, Polish examples in this sphere are but the start of a new path that leads to the concept of an eco-friendly, functional and beautiful city and perhaps most importantly—oriented towards the resident.

This study is published as a part of a research cycle concerning structures with new, pro-environmental functions as innovative elements of urban and suburban structures. This research is conducted in two structure groups. The first group includes thermal waste processing plants, the second—wastewater treatment and purification plants. This research has been presented in the form of a matrix structure (cf. [3]), and was later classified into four thematic groups, as presented in the table below:

| Table 1. Matrix structure of the research being conducted—presented as a table (original work). |
|---------------------------------------------------------------|
| **Group 1** | **Group 2** | **Group 3** | **Group 4** |
| Social | Architecture | Locations/Accessibility | Urban Relations | Technical Issues |
| Thermal Waste Processing Plants | S/TWPP | A/TWPP | L/TWPP | U/TWPP | T/TWPP |
| Wastewater Treatment Plant | S/WTP | A/WTP | L/WTP | U/WTP | T/WTP |

The following studies have so far been published as a part of this cycle:
- concerning matters of a social character in reference to thermal waste processing plants (S/TWPP – "The beauty of eco-technology – thermal waste processing plants as structures that increase the attractiveness of city spaces");
- architectural matters in reference to thermal waste processing plants (A/TWPP – “The beauty of ecotechnology - thermal waste processing plants as an structures that increase the attractiveness of city spaces”), as well as wastewater treatment and purification plants (A/WTP - „Beauty in eco-technology – a sewage treatment plant as a spatially attractive structure”),
- spatial matters (two articles focusing on the subject of the location and accessibility of each type of structure): L/TWPP – „Thermal waste processing system structures. Questions of locations and
accessibility – Polish experiences” i L/WTP - “Accessibility of sewage treatment plants - benefits and limitations associated with their location requirements”, as well as one article concerning the spatial relationships of thermal waste processing plants U/TWPP - “On the cusp of the new spatial challenges – the thermal waste processing plant as an element of urban space”)
- technical matters and their impact on the architectural expression of structures, as well as its spatial significance (T/WPP - „From technology to a landmark – selected thermal waste processing plants in Europe”).

This study supplements the cycle in terms of the subject of the public reception of wastewater treatment and purification plants (S/WTP).

2. Analysis of the problem of the public acceptance of municipal wastewater treatment plants— a look at the past

The problem of the collection of household waste appeared when man shifted from a nomadic lifestyle to a settled one. The settlement, as a permanent place of residence, was typically placed near a river or lake, which provided access to water, and oftentimes also guaranteed safety. However (sometimes because of the growth of the settlement) water access was not automatically equivalent with access to drinking water—which was a key problem for obvious reasons. Over time, the cause of disease became connected not only with the so-called "miasma", but also with a lack of access to a clean, unpolluted river or lake. The possibility of digging wells alleviated this problem to a degree, however, considering the rapid pace of the development of places of human residence, this was not a solution that fully guaranteed that its stated goal would be achieved. The first attempts at collecting human waste were so-called "cesspits" which were dug in areas outside of settlements.

Cesspits, after a natural partial drainage of sediments and fermentation, were covered with earth and new ones were dug far away from water sources, which was a beneficial solution concerning the times, but ceased to be effective when faced with a growing population. Residence in a city compounded the difficulty of the removal of waste and wastewater on the one hand, while on the other was the cause for the search for a new, more effective approach. Gutter systems were a deliberately organised attempt at solving the problem of wastewater removal, however, it had numerous flaws: it did not sufficiently address the problem of the pollution of the city, which affected the health of residences, nor did it solve the problem of unpleasant smells. Furthermore, it was ineffective in the case of negative temperatures—wastewater would freeze and it was necessary to hack it apart and transport it outside the city in frozen-solid form [4].

The use of sewerage in the form of covered piping in cities partially solved the problem of unpleasant smells and direct epidemiological threats. Early sewerage used the effect of gravity to transport sewage and newly introduced sedimentation tanks were placed at the lowest level of the city limits or outside of them. Due to the necessity to mechanically propel wastewater after sludge sedimentation, they were typically placed near rivers, but were distant enough so as to not endanger cities directly. The previously encountered difficulty in the form of the necessity to constantly search for a new place for cesspits forced the pursuit of a solution that did not require the constant relocation of a wastewater disposal site. The application of a two-chamber tank with a sedimentation chamber in which the wastewater was collected and a fermentation chamber in which the settled sludge would ferment, be taken away afterwards and dried in specifically delineated areas constituted a solution that was beneficial during its time. It had proven itself enough that in some places in Poland it was still in use as late as the first half of the twentieth century.

Finding a new method to gather wastewater and solve the problem of gravity sewerage meant new possibilities, but also new challenges. The first notable social conflicts associated with wastewater disposal started to appear. Spreading the sewerage network made it possible to place toilets inside buildings and later inside apartments. In both cases the idea was met with resistance from city residents.
These types of solutions were seen as extremely unsanitary or at least harmful to health. Raising awareness on the subject of the operation of sewerage and contemporary examples of good practice allowed the new technological solutions in this field to gain broad public acceptance. At present—it would appear—we are facing a similar transformation of social acceptance (or a lack thereof). Raising awareness concerning pro-environmental efforts and the role of municipal wastewater treatment plants in them (as well as their role in the urban structure) appears to be key.

3. Results and discussion—evaluation of the present and a look into the future

Municipal authority action plans that are in concordance with the ideas of sustainable development are a significant aspect of contemporary municipal policy, however, their actual execution or, perhaps what is even more important, the interpretation of these ideas, is often a separate matter. Oftentimes, the notion of sustainable development becomes a slogan that is separated from its meaning—a slogan that is used in such a multi-threaded, multidimensional manner and in such different contexts that we can easily say that a blurring of its original meaning is taking place. Similar conclusions can be drawn based on analyses of the use of the words "eco-friendly", "pro-environmental" or the concept of the "eco-city" in public discourse. Due to the multitude of contexts and meanings that are often dependent both on individual interpretation or the field and even scientific discipline, in which a given discussion takes place, the understanding of what is "eco-friendly" and what an "eco-city" actually is leaves a broad margin for interpretation.

Against this background, the combination of two meanings appears to be key: on the one hand, that of eco-friendly actions and the concept of the eco-city, with engineering elements on the other. The latter are often equated in the public eye with the "negative, industrial" aspect of the city rather than a "clean, eco-friendly idea". The subject of structures that comprise municipal engineering infrastructure, in a social perspective, is at the point of contact of three disciplines: architecture and urban planning (as disciplines that refer to space), sociology and the social sciences (as disciplines that discuss the user of said space), as well as strictly technical and technological matters, which, though sometimes being "invisible", can significantly affect both space and its users. When discussing wastewater treatment plants from this perspective and in reference to Polish experiences, it can be stated that:

- From an architectural perspective, these are structures that have thus far constituted merely an element of a city's technical infrastructure. In terms of their placement, the elements that have been considered included good accessibility to a river as a reservoir for purified water. Architectural matters remained unnoticed, as the form of the structures, dominated by their technological function, merely constituted a sort of "packaging" for their function. Care for their form, proportions or visual reception was of little significance when compared with functional parameters. Simultaneously, even these structures (a municipal wastewater treatment plant is typically made up of around a dozen structures with various functions) in the case of which a certain freedom of shaping their massing does exist (laboratory or administrative buildings), they merely remained a technical supplementation of the whole, a visually insignificant addition. Such an approach to architectural form affects the public reception of wastewater treatment plants. At the same time—following examples of good practice from other countries—these structures, because of their placement (close to rivers) and the attractiveness of the elements of their surroundings (the possibility of using water as an element that improves the quality of space), and also through interesting technological inspirations that were reflected in the architecture of buildings, can constitute visually attractive objects.

- From a technical and technological perspective, new solutions create new opportunities not only in matters of the protection of nature, but also those that affect the function of structures—and through this, their social significance. New possibilities in terms of modernising the technological
installations of wastewater treatment plants cause these types of structures to significantly reduce their negative impact on their surroundings. This is associated with both safety (which creates opportunities for the introduction of ecological education on plant grounds—e.g. visiting the plant thanks to placing education paths etc.), as well as with an improvement of wastewater treatment parameters. These are particularly important efforts, as—based off of examples of public discussion concerning the matter of the construction of wastewater treatment plants in Poland—the subject of safety, reliability and its associated impact on the environment of human life have been some of the key arguments causing tensions and public opposition.

- From a social perspective, of note is the fact that a key role in the process of the "acclimatisation" of a new structure in urban or (which is more often the case) suburban tissue is played by ecological education and preceding information campaigns concerning a project, its future operation, possible threats, etc. Awareness of these matters and transparency of conduct appears to be key in this regard, which can clearly be seen during the observation of conflict situations in this field. At the same time, the fact that in public discourse wastewater treatment plants are received much more positively than, for instance, newly built thermal waste processing plants, is worthy of attention, although the first of these to be built, if left unmodernised or found to be prone to accidents, can indeed inflict much greater inconveniences than those that followed, built in accordance with the latest, pro-environmental solutions.

4. Conclusions and observations
The development of technology and the simultaneous rise in awareness concerning the necessity of protecting the environment results in numerous transformations concerning the space of cities. This directly impacts the significance of these elements of engineering and architecture that are connected with the concept of a sustainable and eco-friendly city in public discourse. One of the more significant structures that are directly tied with the protection of the environment of human life and technological transformations, in addition to having an impact on urban space, are structures that form the engineering infrastructure of the city. Technical and technological changes lead to a situation in which engineering elements that have thus far only fulfilled the role of a necessary, albeit unattractive infrastructure, can now gain a quality of their own, a new additional function in terms related to both space and use, but, more importantly, they can become significant elements of urban and suburban space—including in the social sense. Examples of such include wastewater treatment plants—although not as spectacular as currently built eco-friendly incineration plants, they are equally significant and undergo technological transformation equally intensively, standing before the opportunity to create a new quality within cities. An eco-friendly quality, one that shapes the conscious. Based on the author's research and observations, the following conclusions were formulated:

- Municipal wastewater treatment plants in Polish cities are largely limited to solely fulfilling functions associated with being a part of engineering infrastructure. In the face of constantly modernising technology, they nevertheless possess considerable potential to—following similar structures outside Poland—fulfil additional, socially significant functions. These are primarily functions related with environmental education. At present, attempts at pro-environmental efforts are only made in a small minority of these structures, however, due to technical and organisational considerations, these are singular cases, limited to episodic plant visits.

- At present, the construction of a municipal wastewater treatment plant often encounters public opposition when a given area is already being used by a local community, e.g. as a seasonal bathing spot or a place for walks and recreation near the water.
Contrary to thermal wastewater treatment plants, significant public opposition is faced by the construction of industrial wastewater treatment plants. In this case, reactions and the activity of the public are similar to the ones in cases of constructing thermal waste processing plants.

In comparison to, for instance, municipal waste processing plants, wastewater treatment plants—during their placement and construction phase—faced less public opposition. It can be assumed that this was the case because of the different period in which they were constructed: Polish wastewater treatment plants were typically built during a period of a centrally-controlled economy. This was associated with the residents having less agency and fewer possibilities of voicing their opinion in public space. At present, wastewater treatment plants are merely being remodelled, expanded or modernised—which is typically seen by the public as an improvement in quality and does not result in significant controversy.

Water, which is seen by the public as a highly regarded element of urban structures, can play an important role in raising resident awareness concerning the possibility of using wastewater treatment plants in a more social manner, instead of merely as an engineering facility. The positive reception of waterways, waterside greenery, etc. as elements of the composed spaces of wastewater treatment plants can, similarly to good solutions from other countries, be used to promote the additional eco-friendly form of use.

In order to increase public acceptance of wastewater treatment plants, apart from public consultations and raising the awareness of residents about the significance of pro-environmental action in general, a highly essential role is played by easily accessible information campaigns targeting residents, focusing on not only a given structure (either one that is under construction or being remodelled), as well as development project-related efforts on a broader scale and at every stage of completion. The process of public acceptance is particularly dependent on the transparency of actions when introducing new solutions, information that is readily available to residents concerning the project, its safety, impact on space, neighbouring areas or the environment. The presentation of examples of good practice—ones that are already built—as well as the benefits to residents that are the effect of the construction of these types of structures, appears to be equally significant in the consultation process.

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