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ABOUT THE HISTORY OF SEWERAGE AND TREATMENT PLANTS

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Abstract In this paper, the authors aim to present some aspects about the history of treatment plants. If the importance of providing drinking water for a community has been paramount since the beginning of mankind, sewage and wastewater treatment have become widespread only in the modern era. Water consumption increased with the industrialization. The populated centers developed and the population density increased also. At first, after the sewerage networks were built, the sewage, regardless of its nature, was discharged directly into the river. Subsequently, the purification of these waters became a necessity. The first treatment plants offered only a mechanical treatment. It is interesting to see how they were made 100 years ago.
Keywords: wastewater, waste water purification, sewage treatment plants, water quality

1. THE OBJECT AND THE NEED FOR SEWERAGE

Sewerage comprises a complex set of constructions and installations, which have the role of taking over a certain category of water, called sewage waters, to ensure its transport and proper treatment and its return to the natural circuit. Sewerage is vital in ensuring the hygienic-sanitary and comfort conditions of the population, whether it does refer to the household or the economic environment. It is not possible at present to conceive of a human settlement, regardless of its size, that does not benefit from quality drinking water. It is equally important to ensure the controlled removal of sewage waters. Water supply and sewerage cannot be separated, as they are part of the great circuit of water in nature. The sludge resulting from the treatment must also be neutralized and stored so that it does not become a hazard (pathogens and heavy metals). Chapter two presents some historical achievements related to the evolution of the sewerage concept and chapter four presents technical solutions used in wastewater treatment plants since the early twentieth century.

2. SEWERAGE HISTORY

Sewerage works are not innovations of modern times, they date back to antiquity, [2]. If for a human settlement the presence of a water source was of utmost importance, the cities of antiquity developing in the vicinity of watercourses or springs, it became equally important the removal of waste resulting from human activity, insurance against floods and avoidance the discomfort created by stagnant water in the immediate vicinity of buildings. It is assumed that people made a connection between unhealthy living conditions and the appearance and spread of diseases.

The oldest canals, as we understand them today, were discovered in Pakistan, the city of Mohenjo Daro, dating back 5,000 years. They were used to evacuate dirty water from human activities but also rainwater. The canals were placed on a slope and took over the waters from palaces and temples, [2]. In India, the hearth of an ancient city with canals located on both sides of the street was discovered, and also in India, the first sewer pipes made of ceramic tubes were discovered.

In Egypt, canals were discovered made of stone and brick, for the evacuation of dirty water, which were executed 2500 years before our era, [1].

In ancient Greece, stone and brick canals were made, with a semicircular section, which collects dirty water from public baths, palaces and temples, but also rainwater. These waters were led to gardens and orchards where they were used for irrigation, [1]. It is perhaps the first historical attestation from which it results that people realized that these dirty waters were valuable even by their content, contributing in addition to irrigation and fertilization of agricultural crops.

In ancient Rome, the most famous sewerage work is the Cloaca Maxima, started more than five hundred years before our era, it is partially in operation today. Cloaca Maxima is the most remarkable sewerage work that has been preserved to this day and can be considered a prototype of an urban sewerage. Initially, some existing watercourses were re-profiled, which merged into a main collector with overflow into the Tiber River. Subsequently, the works were extended through branches, and the open channels were partially covered, providing land for construction. This system of channels was designed for taking over both dirty and rainwater, water from ponds and swamps. The channel also served to remove solid waste.

The Middle Ages meant a setback for this category of works, which led to the eruption and

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spread of terrible epidemics, water epidemics such as typhus, cholera and others.

It should be noted that regardless of the historical epoch, the human settlements were configured in such a way that at least the rainwater flows in a controlled way, on the shortest road, outside the locality, thus avoiding its flooding. For this, simple ditches were arranged or small existing watercourses were used.

In the modern era, with the advent of industrialization and population concentration in cities, sewage and garbage disposal has become a necessity from a hygienic point of view. Due to the dirty water, the wells were slightly contaminated and the stagnant water and garbage led to the multiplication of rodents and insects and the generation of unpleasant odors and dust. Usually the solid garbage was transported outside the locality or thrown in ditches or in existing natural watercourses. Dirty water from households or manufactures was discharged into pits, from where they infiltrated in the soil. The fact that this process affects drinking water sources was found much later.

The first fully canalized European city was Vienna in 1739. However, epidemics were common, because the population in the areas bordering the city used the streams as an emissary for unloading dirty water and removing solid garbage, but also for washing clothes. Thus, the groundwater captured from the wells in the city was contaminated. After the cholera epidemic of 1831, most of the streams were covered, thus forming a system of "channel-streams", which offers a much higher degree of protection. Also, two main, high-capacity collectors were built, parallel to the Wien River, which flows into the Danube. These works were permanently extended, especially after in 1873 the city benefited from centralized water supply. This supply was achieved by capturing springs that provided a very good quality drinking water, which led to an increase in consumption, and therefore the amount of dirty water generated. Thus, between 1893 and 1904, two main collectors were built on the left and right banks of the Danube, and the Wien River was regularized.

In 1842, the foundations of the sewerage of the city of London were laid. Due to the fact that more and more households are benefiting from water toilets, the flow of dirty water generated in the home has greatly increased, exceeding the capacity of the infiltration pits, where it was collected, and leading to their overflow. In 1848, a municipal commission was set up to supervise these works, the Metropolitan Commission of Sewers, commission that also decided to disbandment the 200,000 infiltration pits existing at that time. The works were accelerated following the disaster produced in 1858, known as “The Great Stink”, being an emanation of unbearable odors. These were due to uncontrolled discharges of dirty water, from the household but also from industry, in the Thames River. Due to the heat of that year and the fact that the Thames is a very slow stream, the dirty water has decomposed biologically, not being removed quickly enough. The phenomenon has affected the city's population so much that it has gone down in history. Since the 1840s, cholera epidemics have become more and more common in the city, believing when the disease spreads through the air. In 1854 the doctor John Snow (1813 - 1858), following an epidemic that caused 10,000 deaths, discovered that the spread of disease is actually contaminated water. This finding was particularly important, it must radically influence everything that meant drinking water supply and sewage disposal. By the way of approaching the problems and the ingenuity of the applied solutions, the London sewerage can be considered a reference work in the field.

In the city of Timişoara, the foundations of the sewerage were laid in 1909 under the Austro-Hungarian Empire, [5]. The works were led by the engineer Stan Vidrighin, (1876–1956, graduate of the Technical University of Budapest), starting with the construction of the two main collectors on the right and left bank of the river Bega, which were continued with secondary collectors and pipelines. on duty. This first phase ended in 1911, meaning a special technical work, which was to continue with the city's treatment plant, located on the right bank of the river. The sewage treatment plant built by Stan Vidrighin is now a museum.

3 TECHNICAL SOLUTIONS APPLIED TO THE FIRST TREATMENT PLANTS IN EUROPE

The settling tower, figure 1. They were developed from vertical decanters by hermetically closing them and making a part of the construction (upper part) above the ground. The upper part is made of metal sheet like a bell. The tower in the image, executed by the Röckner-Rothe company from Berlin, has a diameter of 11m. The tower works in siphon, therefore its height is limited. Water enters the base of the bell and is taken from the top of it. The sludge is collected at the bottom (underground part of the construction). A scraper is used for a good collection of sludge.

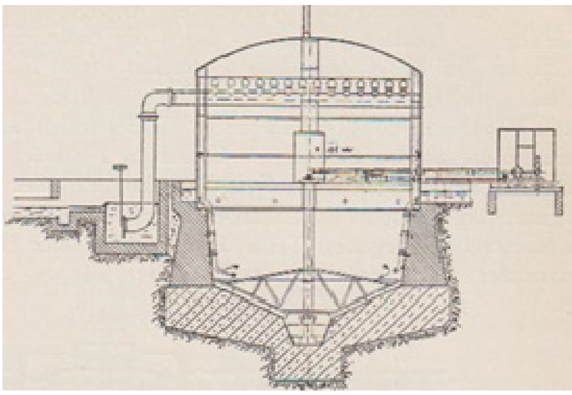

Figure 1. Settling tower Röckner-Rothe Berlin ([1], p.p. 683)

Another settling tower, figure 2. It is a metal construction made completely above the ground. The water has an ascending course, penetrating at the bottom and being taken at the top. It is also a watertight construction. At the top, in the bell, there is a pipe for the evacuation of gases and fats.

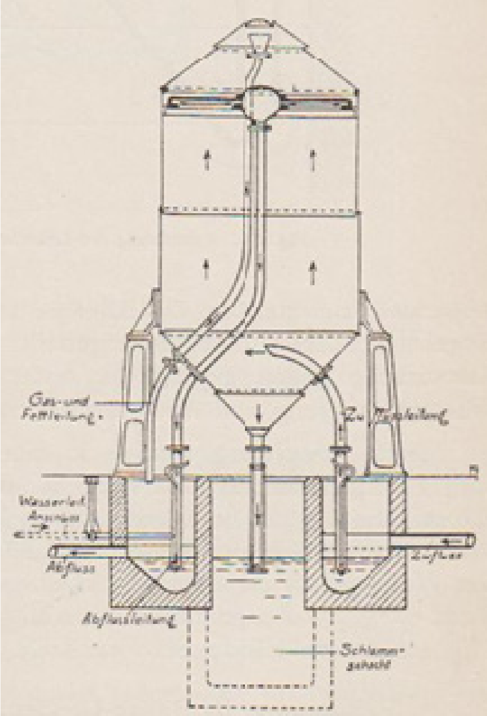

Figure 2. Settling tower, Patent Merten, producer A.G. Ferrum Berlin-Kattowitz, ([1], p.p. 683)

The classic longitudinal rectangular settling tank, figure 3. The construction shown in the image is slightly different from the one used today due to the base and several sludge sumps. The base of the settling tank is inclined from both sides towards the center where the sludge sumps are located.

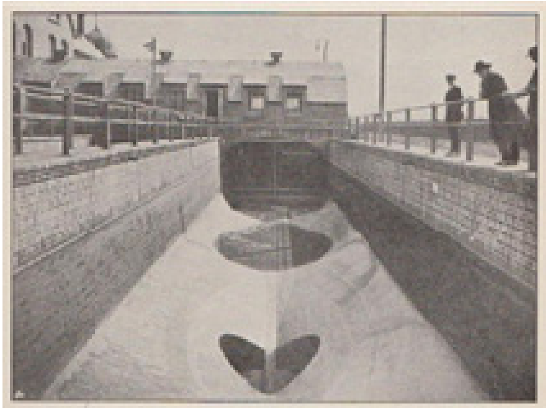

Figure 3. Longitudinal rectangular settling tank with several sludge sumps, ([1], p.p. 675)

An interested settling tank is the one patented by Christian Kremer, also called the Kremer cell, figure 4 a) and b). The water is introduced centrally and follows a descending and ascending path like a labyrinth. This results in better separation of the solid phase. The sludge is collected in a deeper basin separated by a dam.

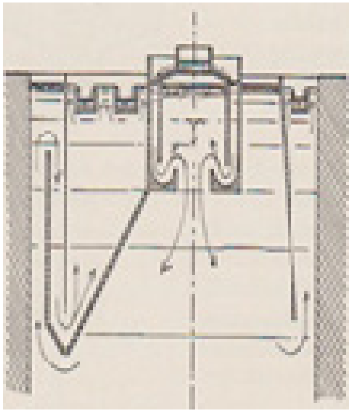

Figure 4. a) Cross profile Kremer cell, ([1], p.p. 684)

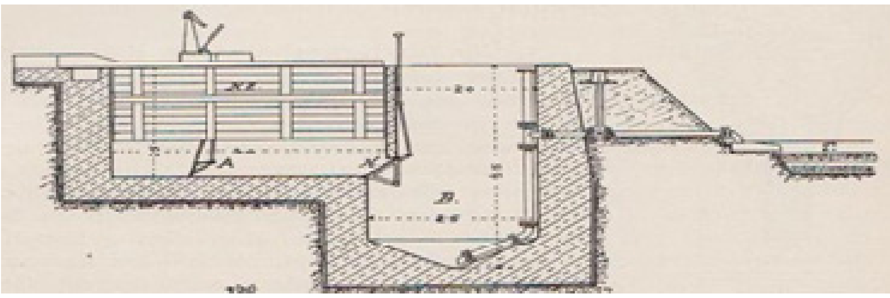

Figure 4. b) Longitudinal profile Kremer cell, ([1], p.p. 685)

Trickling filters, figure 5. These models of trickling filters were made at the Wilmersdorf treatment plant near Berlin. The filling material is coke and the water is distributed by a rotating system.

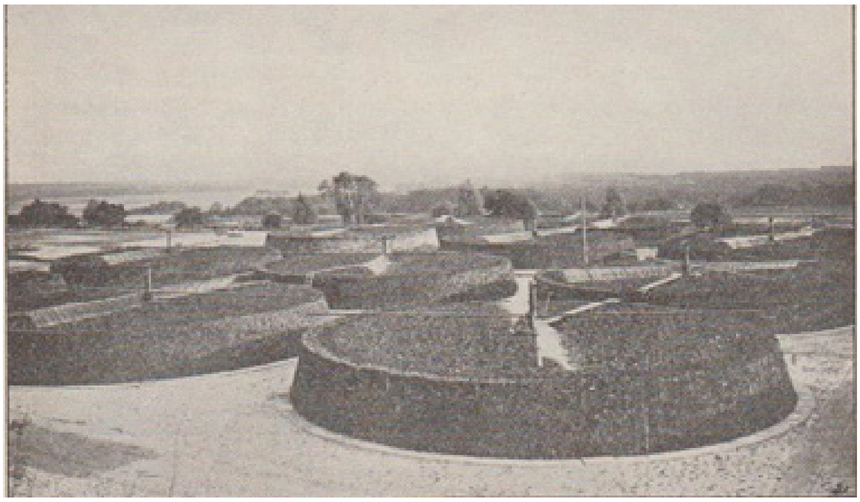
Figure 5. Trickling filters, treatment plant Wilmersdorf, ([1], p.p. 746)

Settling ponds and infiltration fields, figure 6. The construction in the image received the sewage from the Berlin-Malchow area. In the background of the image is the level indicator tower. Through these ponds fertilizers from sewage waters (N, P, K) can be used, (under certain conditions).

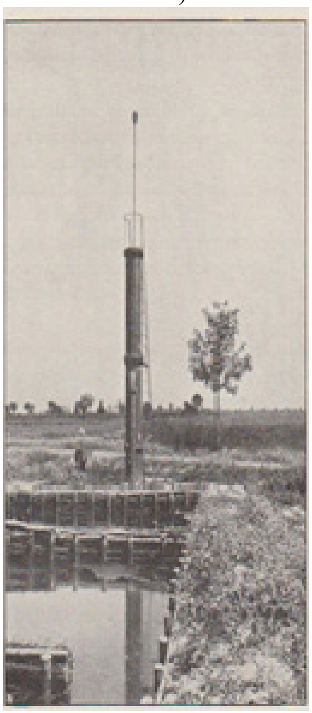
Figure 6. Settling ponds and infiltration fields, Berlin-Malchow area, ([1], p.p. 772)

4. CONCLUSIONS

Since ancient times, the need for sewerage has been imposed where there was a controlled water supply system.

The fertilizing effect of the wastewater was observed and where necessary the wastewater was used for irrigation.

In the Middle Ages there were great cultural, political, economic and technical achievements but it meant a decline in water supply and sewerage.

The finding that diseases can be transmitted through water, which can cause epidemics, imposed the sewerage system as an objective necessity.

The treatment plant is an integral part of the sewerage system regardless of the cost or technical problems that may arise in its construction. We mention this aspect because there are many localities that do not yet have a complete sewerage system.

A high-performance sewage system (including sludge processing) means a clean environment.

Direct discharge of sewage water in nature (self-treatment of water and soil) cannot be considered as an alternative solution for a treatment plant.

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