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URBAN WASTEWATER MANAGEMENT IN FOCUS OF HEAVY METAL CONTAMINATION

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Abstract: *In our study, we focused on urban wastewater management, with special regard to the problems caused by heavy metal contaminations. Heavy metals function at low concentrations as a biogenic element, but at the same time in higher amounts (especially above the limit value) are considered as pollutants. We determined the basic wastewater treatment problem: which is the main problem of heavy metal contaminated urban wastewaters and how could eliminate heavy metals. We focused on wastewater origin heavy metal mobility in environment and effect (risk) on human health. In the following, we undertook to analyse urban wastewater in this direction.*

Keywords: *water management, urban wastewater, water pollution, heavy metal content, process analyse,*

1. HISTORICAL RELATIONS BETWEEN THE DEVELOPMENT OF WASTEWATER TREATMENT TECHNIQUES AND URBAN POPULATION CHANGING

The quantity and composition of communal (residential) and industrial wastewaters, following the evolution of urbanization and society, has constantly changed over the centuries. Initial methods of sewage treatment can already be seen in ancient civilizations (Egypt, the Roman Empire). In Rome, the drainage of wastewater produced by the population, modern canal networks have been developed today. In addition, the initial signs of sewage sedimentation can be observed, as digestion pools have been created for sewage desalination. The sediment-like material deposited here was tried to recycle in agriculture and the sewage collected through the canals was first led to the Tiberis and then into the sea. The latter is now considered environmental pollution, but considering the possibilities of the age, it was a highly developed method.

In the medieval settlements (nowadays) an open sewage network was used, ie the amount of communal wastewater produced in households and guild places was untreated, untreated, and flooded into uncovered channels on streets. Subsequently, many human health problems are attributed to this solution, enough to think of plague epidemics causing hundreds of millions of deaths or Coli (*Escherichia coli*) infections. The beginning of the development of sewage treatment can be dated to the second half of the 19th century. The primary task was solving wastewater disposal.

Although ancient civilizations have already solved this issue, however, industrial society waterways with a much higher concentration of pollutants have been reported to the communal sector for the 19th century societies of industrialization. By the middle of the 19th century, it was possible to settle sewerage in several large cities in Europe, including London, so it was possible to take collected effluents into a kind of reservoir and isolate it from the populated areas, but sewage from the canal was often released to the Thames. The doctors of the age suspected that a significant part of the devastating epidemic during the century was due to untreated sewage that poses a risk to human health. In 1876, Robert Koch, a German physician, a microbiologist, isolated tuberculosis, cholera and gut bacteria, and proved that infections (epidemics) are spread in aqueous media, in many cases through sewage. This important result is not only a pioneer discovery of modern microbiology but also a starting point for future biological wastewater treatment processes (SZOBOSZLAY, KRISZT, 2010).

The industrialization wave that started in the 19th century also affected the New World, the United States. In the last years of the century, the factories and plants on the east coast have overexposed surface and groundwater near big cities. Since the majority of large cities in the century were built along watercourses (due to drinking water supply, sewage water supply, industrial water needs), short-term overcrowding resulted from high concentrations of watercourses. Although channelling the sewage into surface waters (ponds, rivers) and thus have serious environmental impacts, this solution has yielded so many positive results that by the end of the 19th century virtually all world epidemics and waves of contagion caused by the deaths of millions were virtually eliminated. The world's first serious and large sewage treatment plant in Hamburg was built in 1842. Looking at the eye, looking at the technological level of development and possibilities of the era, this was a technological joke. A mechanical (filtration) and pre-cleaning process was developed. These methods have solved the two most important (at least the most important) sewage problems in the era. The turbidity of the sewage, the floating content of the sewage was visibly visible. By mechanical cleaning, they also spared pumping pumps moving into the plant as filters and lattices were already installed in the pipeline network. The greatest achievement of the era was the pre-breeding technique. Even today, roughly 30% of the contaminant content measurable in the COD and BOI values could be deposited. With the introduction of prefabrication, the number of sewage treatment plants has also increased, and it has been similar to today's well-known sewage treatment plants.

The first biological sewage purification experiment was groundwater sewage filtration in the 1870s. This method can be considered as the forerunner of drip irrigation and sludge sewage treatment technologies developed in England, as the country's special climatic conditions favoured the technology's operation throughout the year.

In parallel with the development of cleaning techniques, an unknown substance, sewage sludge, appeared. The methods used so far were not suitable because the sewage sludge has a duality: it has a high water content (more than 90%), but there is also a significant amount of solid phase, which typically means organic matter left after aerobic microorganisms. They realized that if sewage sludge were left to stand anaerobically for an appropriate period of time, anaerobic degradation processes would start in it (the intensity and efficiency of the decomposition increases with increasing temperature). At the same time, it was determined that the mesophilic range is ideal for sludge treatment (~ 33^{o}C). This method is known today as anaerobic sludge stabilization. The sewage sludge thus treated could be dewatered with good efficiency, which meant that sludge storage was easier and on the other hand, the recovered solid phase, the organic material, could be properly composted.

By the 20th century, it became clear that the amount of wastewater produced should be treated mechanically and in a different way, as it has attributed a number of infections, stigma and odour. With the development of industrial technologies and the use of often polluting techniques, industrial pollutants of constantly changing pollutants were also created, which were much more challenging for the professionals of the era. Neither communal nor industrial sewage could be introduced into the natural water streams (receivers), as the concentration of pollutants far exceeded the self-purifying ability of watercourses and lakes. In the years before World War I, the modernization of sewage treatment plants typically meant the technical (engineering) development of settling structures and sludge fermentation facilities. Major improvements were made in the United States, England and Germany.

At the beginning of the 20th century, a new method for assessing the quality of water was used, which was used for both wastewater and drinking water quality. This is the saprobium test. Monitoring of the *saprobibites* of watercourses in addition to big cities. Saprobitum means the amount of biochemical degradable organic substances from water heterotrophic organisms. Characterization of KOI_{ps}, KOI_d, BOI_5 is used (SZOBOSZLAY, KRISZT, 2010).

In the second half of the 20th century, biological purification has been undergoing continuous improvements. The efficiency of cleaning has increased, and the methods used have widened. Today they are using bio-film, drip-rinsed, sift-free, "live-machine" adsorption methods without the need for completeness.

2. MANAGEMENT ANALYZE OF URBAN WASTEWATER TREATMENT PROCESS

Wastewater treatment is one of the most important environmental technologies, and is therefore used in almost all major settlements. In order to protect our environment, we cannot allow wastewater from factories, plants and the public to be impregnated in our lakes and rivers. There are also a number of canals along the Danube where the dark colored, stinking sewage flows into the living water. Unfortunately, despite the aspirations, they still resort to this „solution" in many places, but luckily, wastewater treatment plants are getting more and more wastewater. In the colonies, these sewage is cleaned by various techniques, and then, through pure water (through the channels), they are recycled into rivers and lakes.

Daily wastewater from communal and industrial sources is collected through sewer networks. Based on the nature of the collection, we can distinguish between unified and separated channels (EASE, 1995). A combined system is referred to when sewage and rainwater fallen into the provided area are transported in a common sewerage network. The system is separated if sewage is discharged into sewers, and a separate drainage channel runs the precipitate. As a combination of both, a so-called mixed system is created. There are pollutants that can be found in any sewage regardless of type. These are the following:

- Solid state materials
  E.g. floats, sand, pebbles, dirt on the surface of the waste water
- Dissolved solids and gaseous substances
- Inorganic compounds
  Most of the inorganic pollutants are acids and alkalis. There are many concentrations of industrial sewage, and effluent discharges without proper neutralization affect the balance of the natural system of the incoming watercourse
- Organic compounds
  Any substance derived from the breakdown of living organisms or any degradation product containing open or closed carbon chains
- Metals, semi-metals, heavy metals

It is enriched with the flocculent of sewage. It is also important to mention non-metallic batteries, as some of them are toxic. These may include various cyanide forms, hydrogen sulphide and fluoride. Of these, the cyanides are the most dangerous, for example, alkali cyanides are extremely toxic to living organisms at concentrations of several hundred mg / dm^3.

In the first instance or in mechanical cleaning, the physically separable, sunken floating and floating materials of the sewage can be removed by means of grids, filters, settling devices (EASE, 1995). This provides for a few simpler sewage disposal methods, but in modern sewage plants it usually only counts as the first stage of cleaning. Mechanical cleaning includes the removal of sand in the wastewater drainage system (using sand dredgers).

During secondary or biological purification, the microorganisms in wastewater are digested and mineralized, and the organic matter of the wastewater is transformed into living cellular material, thus the water contamination is significantly reduced (ROTMISZTROV et al., 1982). Microorganisms operating under aerobic conditions (in the presence of oxygen), causing air or pure oxygen to enter the system usually decompose organic substances. Two of the most commonly used technologies for artificial biological purification are the sludge and drip rinsing. The aerobic method used for demolishing dissolved organic matter in the wastewater is drip irrigation (ÖLLŐS, 1995). In pre-impregnated waste water in traditional (coarse-grained) and plastic drip bodies, the pre-impregnated waste water is cleansed due to the degradation ability of the micro-organisms of the biological membrane deposited on the high surface area (EOL, 1995). The wastewater is applied uniformly to the filling material. Aerobic conditions required for degrading microorganisms are in most cases guaranteed by natural air movement. Sludge treatment is the most commonly used method. The mechanically pre-treated wastewater is transferred to a massive sludge pool containing a mass of microorganisms where the sludge effluent mixture is aerated, blended and streamed to keep the microorganisms alive and in large numbers renewed (ROTMISZTROV et al., 1982). After a certain period, the active sludge is separated from the water phase by sedimentation, part of it is discharged as a sludge, and the other part is recycled to recycle the “coming” wastewater.

In a third stage, inorganic substances (such as nitrate and phosphorus) are produced as the final product of the biological grade (ROTMISZTROV et al., 1982). This degree is applied where the receiving water is sensitive (e.g. standing water, low flow water streams). Sludge is an inevitable by-product of artificial purification, most of which is the mass of living and dead microorganisms produced by biological purification, which are removed from the utensils. The smallest part of the so-called “cleaner” in the mechanical cleaning stage, on the bottom of the pre-filler (s) raw mud (ROTMISZTROV et al., 1982). Sewage sludge treatment is defined as all the procedures that are carried out with the resulting sludge at the sewage treatment plant to reduce volume and infectivity, manageability, usability and positionbility (BARÓTFI, 2000). As the water content of municipal sewage sludge is high (95-98% on average), the most common method of treatment is to reduce the moisture content of sludge, because this process will significantly reduce the sludge to be treated further, with significant economic impacts.

Treatment methods are basically determined by the composition (origin) and further use of the sludge. Common to agricultural areas (due to the availability of nutrient content) or placement in areas to be cultivated. The following metrics are used to measure the organic matter content in wastewaters (BARÓTFI, 2000):

- Chemical oxygen demand (COD)
- Biological oxygen demand (BOI_5 and BOI_{20})
- Total Carbon (TOC).

Biochemical oxygen demand measures the biodegradable organic matter content of the wastewater. BOI refers to the amount of oxygen used by degradation of organic pollutants by microorganisms, measured in mg O_2/dm^3. Not all of the organic pollutants in the wastewater can be biodegradable, so that all organic pollutants can be quantified by chemical oxygen demand. A strong oxidizing agent (potassium bicarbonate or potassium permanganate providing rapid determination) determines the amount of oxygen that is chemically oxidable with organic matter. The disadvantage of the methods used to determine the COD is that the reducing inorganic substances present in the water also react with potassium permanganate or potassium bicarbonate. Therefore, the determination of the carbon content of water (TOC) is becoming increasingly widespread.

3. HEAVY METAL CONTAMINATED URBAN WASTEWATERS

There are several industrial plants in Hungary and in the world, with heavy metals containing wastewater from the technological process. The most common heavy metal emission technologies include iron and steel, metallurgy, mining (though this is virtually eliminated in our country). In addition, it is typical that heavy metals, including galvanization, battery and battery manufacturing, coke ovens and other industrial activities, are also heavy metals in technological water (sewage). The listed industrial technologies are activities whose wastewater contains not only heavy metals, but also other environmentally harmful substances (e.g. organic matter residues, acids and bases, inorganic impurities). In many cases, high temperatures in technological waters should be also raised (due to heat pollution).

A special case is the nuclear power plant that emits polluted water that is specially contained in nuclear energy activities. Such pollutants include large amounts of radioactive isotopes, breakdown products, heat pollution and spent fuel. Mining is an industrial activity with environmental degradation, which is limited in many European countries (e.g. Hungary) or has ceased. From an economical point of view, it was important for the industry for a long time to bring out the mineral resources in the geological medium (surface-mined or deep-milled mines). In mining activities, in many cases, irreversible environmental degradation and pollution are taking place. The materials used and technological by-products are placed in the natural environment (e.g. in the Mátra's rivers), in the form of ditches (taking into account the landscape aspects in a good case). If the insulation of the ditches is inadequate, heavy metals, inorganic and organic pollutants enter the environment, they infiltrate the soil with soaking in the soil, so that they can reach kilometers. The previously mentioned ROODBERGEN et al. (2008) and HSEU et al. (2002) have also shown that the heavy metals are environmentally significant (Figure 1) and heavy metals are sometimes included in the food chain.

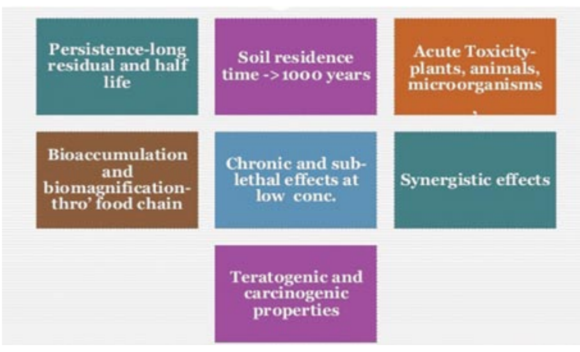

Figure 1. The toxicity of heavy metals in environment (ZHANG, 2011)

4. ENVIRONMENTAL MOBILITY OF URBAN WASTEWATER'S HEAVY METALS

The environmental mobility of heavy metals is the result of the combined effect of several factors. Typically, they are placed in the form of complex compounds in the form of environmental elements (PAHARI & CHAUHAN, 2007). One of the most common ways of (heavy metal) impurities is to get sewage, wastewater, groundwater or surface water from a human activity. Of course, we need to distinguish between releases of the environment and the pollution of the environment. Accordingly, the environment may cause the pollution of any pollutant into the environmental element that overrides the element's balance, changes its natural composition, but does not pass the statutory boundary limit B (PAPP, KÜMMEL, 1992). These loads must be handled with caution because, due to environmental conditions (possible further impacts), and substances entering the environment may become enriched, chemically transformable, thus crossing the threshold that separates the load and the pollution from each other (ZHANG, 2011).

Housing dust resulting from the processing of heavy metals causes serious health and air pollution problems. The movement of small particles (smaller than 10 nm) by the wind, the inhalation of organisms and humans can lead to health and environmental damage (KERÉNYI, 1998).

For the heavy metal pollution, Upper Silesia and Glogów, Poland, are the most seriously affected areas in the world. Here the concentration of Cd, Mn, Zn and Pb in the waters is sometimes hundreds of times the limit. By 1990 the degree of environmental pollution became so severe that some areas of Glogów had to be relocated. The severity of heavy metal pollution was enhanced by the simultaneous contamination of Ni and Cu by the two heavy metals reinforcing each other's toxicity (KERÉNYI, 1998).

Wastewater can be divided into two large groups: industrial and communal sewage. In addition, there are groupings that take into account other classifications, but most often, these are two groups (EOL, 1995). The heavy metal content of industrial sewage can be very significant, thus leaving uncleaned areas in the surface waters causing serious environmental pollution and damage (EASE, 1995).

The heavy metal content of industrial sewage is the result of several industrial technologies that are currently in use. Metallurgical, iron and steel industry by-products and wastewater require three-step sewage treatment, so it is not enough physical (mechanical) and biological purification, but it is also necessary to use chemical purification grade (ÖLLŐS, 1995). In industrial sewage, in addition to the turbidity that causes turbidity and the presence of fine particulate sediment, iron, manganese, copper, zinc and cadmium are high concentrations.

Not only can heavy metals cause serious environmental degradation, but also various organic and inorganic water pollutants. In many cases, hydrocarbon derivatives, other organic molecules (TPH, PCB, BTEX compounds and, in some cases, pesticide residues) can also be detected in concentrations (FÖLDI, HALÁSZ, 2009; SZOBOSZLAY, KRISZT, 2010). Among the water pollutants, metals and their concentrations are one of the important parameters. We cannot accurately deduce the total metal concentration of water as some organic substances make the formation of metal-organ complexes faster, leaving the metals in solution (VARGA, 2000).

Biological communities of the environment (microorganisms) are able to pick up heavy metals that are done during chelation. Consequently, heavy metals may even disappear from the soil or from natural waters in total quantities (can be stated to remain below the detection limit). Due to the biological heavy metal recruitment, the accumulation of heavy metal of biomass occurs.

Numerous international scientific publications deal with heavy metal contamination with environmental elements. BECK et al. (2002) describes the study of surface water bodies Cd, Cu, Ni, Zn and Mn. During their work, samples of water were collected from several sites that measured the concentration of heavy metal by ICP-MS. It was concluded that heavy metal contaminants in surface water are difficult to accumulate in the body of water, except for the heavy metal capture by fish feeding. It has been shown that in the majority of cases the sediment has heavy metal pollution.

DANIELA et al. (2002) In Sicily, the heavy metal contamination of urban soils has been studied in Palermo. Their investigations have shown that heavy metal pollution typically occurs on the shores of Sicily, near coastal areas (offshore), and in many cases, the limit value has been multiplied. Furthermore, the relationship between heavy metal pollution along the shipping routes (water pollution) and heavy metal concentrations in the coastal areas has been demonstrated. Their results were justified by the close relationship between water bodies and geological media. Environmental transport processes have explained the spread of heavy metal pollution.

GRIFFITHS and LAMBERT (2013) in their water management manual published by UNSECO state that a significant part of the pollution of surface water bodies is a consequence of transport and human activities. There was a connection between contamination of surface and groundwater bodies. It has been demonstrated what environmental transport processes and chemical transformations result in the "migration" of heavy metal contaminants between different environmental elements. As related information, it is noted that a significant proportion of heavy metal contaminants in water bodies occur in third world countries where industrial technologies are outdated, almost none of the means of transport (cars, ships, trains) meets the minimum state requirements. Pollution to water bodies is easy to reach the population, and so the number of people who consume high drinking water with heavy metals is tens of millions.

LUOMA and RAINBOW (2005) note that the environmental diffusion of heavy metals is caused by light chemical transformation processes. It is described that most of the heavy metals are easily incorporated into complex compounds, so their environmental transport is significantly improved, and the presence of heavy metals in such a form is more difficult to detect than heavy metals not in complex form.

SASTRE et al. (2012) demonstrate that they are above the concentration limits Cd, Cu, Pb and Zn in their environmental samples (soil and water samples). The concentration in the water samples is explained by the fact that during the treatment of wastewater, the heavy metal content is only reduced to below the limit value, as purified water corresponds to the conditions for the reception of the recipient. However, it has not been reported that the concentration of heavy metal may increase in natural waters.

ROODBERGEN et al. (2008) The Netherlands has studied the appearance of heavy metals in the food chain. During their work, the country was contaminated with a heavy metal and a (pure) area of reference was chosen as a sample. Their studies have shown that heavy metals are easy to appear in the food chain as heavy metal content has been measured in contaminated areas for human consumption. This was mainly due to plant accumulation and animal nutrition.

According to LIGETVÁR (2008), the improvement of water quality as part of hydro melioration can be one of the key elements of the environmental aspect of water management, including the reduction of heavy metal pollution. HSEU et al. (2002) investigated sediment and soil samples and studied heavy metal content. Their results determined the specific method of destruction of heavy metal content measured in sediment and soil.

SELLING et al. (2008) reported that their two-stage anaerobic degradation technique works well for heavy metal contaminations in water. The anaerobic microorganisms they have investigated, as it has been shown by their research that there are anaerobic species that can accumulate heavy metal without affecting their physiological processes, carry out this two-stage anaerobic degradation technique.

YU et al. (2009) reported that when in situ stabilization follows ex situ composting, it will be possible to clean the heavy metal contaminated sediments. According to them, composting as a biodegradation process can be suitable for this. During their investigations, only sediments were investigated, so they did not change to analyze other environmental samples.

ZENG et al. (2004) investigated four types of degradation processes for the purification of heavy metal contaminated compost samples.

KARVELAS et al. (2003) investigated the possibilities of removing heavy metals during the water purification process. In connection with this, SEELSAEN (2005) reported that the alternative filtration method is excellent for the water purification process.

QUAN et al. (2007) worked with six sewage sludge compost samples and analyzed the concentration and quality distribution of heavy metals in the samples. They found that all heavy metals were found in the samples, but the relative proportion of heavy metals shifted towards Cu and Zn.

ANDRIAN and YARMOSHENKO (2014) investigated the water base of a urban environment and measured heavy metal contamination. The accumulation and spread of Pb, Zn, Cu, Ni, Co, Mn and Fe were investigated. Geochemical impacts and anthropogenic impurities were also analyzed during the research.

ABID et al. (2015) have demonstrated in their research that heavy metals are mainly responsible for continuous industrialization, agricultural technologies and other anthropogenic impacts. Because of the toxic effects of heavy metals on humans, plants and animals, hemorrhage is considered to be of paramount importance. A new procedure has been developed: this is the so-called. Remediation with PGP bacteria. These bacteria are capable of bringing heavy metals into a form that is biologically accessible, making it easier to access plants that are already successful in phytoremediation.

SUBRAMANIAN et al. (2015), including the presence of heavy metals in India from the 1980s to the present. According to them, urbanization, use of fossil fuels and agriculture have contributed to the concentration of heavy metals above the limit value in the coastal area they have investigated.

5. HUMAN HEALTH RISK OF HEAVY METALS

Heavy metal pollution typically causes environmental health risks along environmental routes (FÖLDI, HALÁSZ, 2009). They are easily accessed into the food chain (HARIRI et al., 2015) into the soil and into the water bases, which is the peak of the human being (ROODBERGEN et al., 2008).

The human health risk of heavy metals is highlighted as it can accumulate in the human body and can cause serious health problems, including lethal, carcinogenic effects (FÖLDI, FISHER, 2009). One of the most dangerous heavy metals is cadmium, which has been shown to cause abnormal changes in the human body and has a tumorigenic effect. Copper is a small element essential to the physiological processes of plants, so it has no direct effect on humans. Overdose (as with any other micro or macro element) can cause visible changes on the plant. In this case, obviously there is no food processing industry for that plant, so no human consumption takes place. At the same time, there are plant species that are able to accumulate heavy metals in large quantities, and are also susceptible to hyperacidities. In this case the plant has no physiological effect on the heavy metal, it does not cause toxic (visible) symptoms, so these plants are used in the food industry and its consumption end point is man (FÖLDI, FISHER, 2009).

Zinc in small quantities is essential for certain enzymatic processes, so it cannot be considered as an impurity in this case. Zinc also plays an important role in plant auxin production.

Consuming plants containing small amounts of zinc does not cause any health problems in the human body (SZOBOSZLAY, KRISZT, 2010) (Table 1).

Summary, it can be concluded that the environmental mobility of heavy metals is different; the factors that influence chemical conditions, but also the ground and surface water can easily enter the food chain and cause health problems.

Type of heavy metals	***Human health risks***	***Permissible level concentration [ppm]***
Cadmium	Bronchitis, gastrointestinal disorder, cancer, bone marrow	0,002 ppm
Lead	Kidney, mental retardation in children, gastrointestinal disorder	0,1 ppm
Zinc	Skin damage by high zinc pollution	15 ppm

Table 1. Effect and risk of each heavy metals on human health (HASANAH et al., 2013)

6. TREATMENTS OF HEAVY METALS FROM WASTEWATERS

Wastewater containing copper, zinc and cadmium is produced during the production of various industries. The accumulation of heavy metals in the environment intends to develop new sewage treatment technologies. In this connection, BAKKALOGLU et al. (1998) developed a technology based on biosorption and sedimentation. BAKKALOGLU et al. (1998) has studied the comparison of different types of waste biomass-based purification technologies such as bacteria, yeast, and artificial sludge methods and their efficiency compared with sedimentation / biosorption technologies. During the biosorption process, copper, zinc and nickel ions were successfully accumulated by *A. nodosum*, *S. rimosus* and *F. vesiculosus*. On the basis of their investigations it was found that *A. nodosum*, *S. rimosus*, *F. vesiculosus* and *P. chrysogenum* are the most suitable for the conclusion of heavy metals from sewage. The occurrence and the fate of heavy metals (Cd, Pb, Cu, Zn and Ni) were investigated in wastewater KARVELAS et al. (2003) by analyzing the active sludge technology on the wastewater treatment plant in Thessaloniki, Greece. The six types of sewage sludge and sewage sludge used and analyzed for their study were taken at different points of the plant, from both types, to the inlet and outlet of the primary sedimentation tank, or only from the waste water from the secondary settling tank. In their investigations, an exponential correlation was found between the heavy metal partition coefficient (log K_p) and the suspended solid concentration. Except for Pb, the prevalence of all heavy metals in sewage samples was almost 100%, while only Pb was 90%. WANG et al. (2013) reported in their work that the phase distribution of individual heavy metals changed very little during the cleaning process. ULMANU et al. (2003) used copper, cadmium ions to activate carbon, compost, cellulose pulp, sewage sludge. Their investigations show that the copper was sealed except sewage sludge, with the other materials being successful. QUDAIS and MOUSSA (2004) demonstrated that osmotic and nanofiltration technologies are well suited for sealing heavy metal content in sewage. For the underlying tests, copper and cadmium-containing “sewage” samples were used in laboratory conditions. Their results showed that osmosis and nanofiltration were 98% for copper and 99% for cadmium. Thanks to the efficiency of copper removal, synthetic sewage samples decreased the average copper concentration to 3.5 ± 0.7 ppm.

SEELSAEN et al. (2005) experimented with rainwater with heavy metals with compost and sand. For compost, it was found that it possesses the best physical-chemical properties for copper and zinc ions. Compost heavy metal binding properties at pH 5 corresponded to 11.2 mg / g of Langmuir equation. It has been observed that various mixtures of compost, sand and other materials have resulted in increasing heavy metal binding efficiency (Zn 75-96%, Cu 90-93%). In subsequent studies, SEELSAEN et al. (2005) of heavy metal sorption results were based on the 88-97% efficiency of composting. The relative adsorption affinity of compost to heavy metals was in the following sequence: Pb2 +> Cu2 +> Zn^{2+}. The heavy metal adsorption was based on the Langmuir isotherm. Their research has shown that smaller particle composts have better adsorption properties.

SELLING et. al (2008), it is necessary to extend the use of solid biogas fermentation (composting) produced in biogas production in agriculture. At the same time, this activity carries the environmental / damaging effect of undesirable heavy metals. During their investigation, two stages of fermented biogas residues and compost were used. In their work, for six days, leachate waters of different origin were tested, as well as samples of solid fermentation and compost, which heavy metal has binding properties. They found that 70% for Ni, 40% for Zn and 25% for Cd. Only the Cu and Pb were insignificant binding. JAFFAR et al. (2015) in Thoothukudi and Vizhinjam (cities of India) the biosorption potential of heavy metal contaminants was studied using *Phallusia nigra*. During their investigations they focused on the content of Cd, Cu, Hg and Pb. Thoothukud's waters found higher concentrations of heavy metals than water samples from Vizhinjam. The order of the bioaccumulation factors was also determined, according to the following: Pb> Cd> Cu> Hg is the order.

7. CONCLUSIONS

Development of urban wastewater treatment process results some alternative cleaning techniques. The treatment (adsorption) of heavy metals seems to be useful to later cleaned wastewater applications e.g. in the agricultural sector water sanitation. The high concentration of urban wastewaters could disturb the normal ecosystem processes and may cause environmental and human health risk. Some important properties of heavy metals (the mobility in the environment) seems to be helpful to choose the best practice elimination technique. In our study presented some international relations in urban wastewaters treatment methods in focus of heavy metal cleaning efficiency.

All of the observed metals and heavy metals (Pb, Cd, Cu, Zn, Hg) could be treated from natural waters and (urban/industrial) wastewaters with several techniques. All of the described techniques work with specific adsorbing isotherm processes and the question of elimination method could answer with thermodynamic rules. In our study, we described some relevant methods with heavy metal treatment process and its effectivity. All of the methods could be describe with potential isotherm models that was the relevant focus of our study.

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