

NEW APPROACH FOR TREATMENT OF POLLUTANTS IN MUNICIPAL WASTE WATER

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ABSTRACT

In the recent years, environmental issues, especially concerning the chemical and biological contamination of water, the major concern for both society and public authorities, but more importantly. The generic term may be used to describe water containing differing contaminants from other uses, including: Industrial wastewater, water-borne waste from power generation, manufacturing operations and mineral extraction, including, backwashing (water treatment),. The conventional wastewater treatment consists of a combination of physical chemical, and biological processes and operations to remove insoluble particles and, soluble contaminants from effluents. This review discusses the different types of effluents, gives a general process of wastewater treatment, and describes, the advantages and disadvantages of technologies available

I. APPROACH PROBLEM:

The planning to safety sewage became very important in recent years because the increasing in number Population and expansion of cities, and Appearance of the disease and another problem at below :

Every year water and sanitation problems cause more deaths than war and the lack of sanitation is the world's biggest cause of disease.Current cholera affected areas of the world. the world's population does not have access to adequate sewage treatment 48% Must be now provide treatment of sewage and allow bacteria and viruses to contaminate the water table, but now turn the world to planning new treatment to waste water as is the case in developed countries by electricity Sewage treatment plants greatly reduce the risk of disease by purifying the wastewater from a building however the treatment process relies on a constant, reliable electricity supply - a luxury that a lot of developing countries do not have, particularly in rural areas.

It is also a fact that while the investment on provision of sewerage is usually met out of capital grant funding, the cost of house service connections is to be met by the house owners and herein lies another conflict. Whereas houses have not come up in some sectors, these house service connections get time deferred and to that extent, repeated road cuts become a perpetual affair over a long time. As and when the houses are built, service connection requests arise. An approach that has been tried out is the provision of house service connection sewers even in the beginning itself and blank it at the property boundary and connect it only when the house gets built up and the applicant pays up the costs thereof

Here again, it is a question of idle investment at start with no foreseeable return of the same on the house service connection costs.

Another issue is surreptitious connections by house owners and the impracticality of checking each and every such connection by the limited staff of the local body and may well be connivance also.

By opting for decentralized sewer system, first of all, the command area to be supervised for such surreptitious connections get much smaller and the monitoring mechanism becomes effective

The answer asy : What are the modern methods now that must be introduced into the wastewater treatment system ?

II. INTRODUCTION:

Waste water is any water used to transport waste, and is most commonly a synonym for:

Sewage (also called domestic wastewater, municipal wastewater) - this is wastewater that is produced by a community of people.(Soune and Ghat 2004). Black water (waste), domestic wastewater that only contains the discharge from toilets Grey water, domestic wastewater excluding the discharge from toilets

The generic term may be used to describe water containing differing contaminants from other uses, including : Industrial wastewater, water-borne waste from power generation, manufacturing operations and mineral extraction, including, backwashing (water treatment) (Crini 2005) (Cox *et.al.*) (Sharma2015). flushing accumulated particles from filter bed, boiler blow down, impurities concentrated by steam generation, brine, waste streams from water softening, ion exchange, reverse osmosis, or desalination.

The causes of water pollution are multiple: industrial wastes, mining activitiessewage and waste water, pesticides and chemical fertilizers, energy use, radioactive waste, urban development, etc.The very fact that water is used means that it will become polluted: any activities whether domestic or agricultural but also industrial produce effluent containing undesirable pollutants which can also be toxic. In this context, a constant effort must be made to protect water resources (Khalaf 2016); Rathoure and Dhatwalia 2016; Morin-Crini and Crini 2017).

Wet scrubber effluent, containing pollutants removed from smokestack combustion gases to meet air quality goals, produced water, a by product extracted with petroleum or natural gas, leachate, precipitation containing pollutants dissolved while percolating through ores, raw materials, products, or solid waste

Return flow, carrying suspended soil, pesticide residues, or dissolved minerals and nutrients from irrigated crop land

Surface runoff, precipitation carrying dissolved or suspended materials potential damaging to aquatic habitats, including

Urban runoff, water used for outdoor cleaning activity and landscape irrigation in densely populated areas

Wastewater is affected by domestic, industrial and commercial use, thus constantly changing its composition and making it rather difficult to define. Wastewater is used water that has been affected by domestic, industrial and commercial use. The composition of all wastewaters is thus constantly changing and highly variable, which is why it is so difficult to pinpoint a singular definition of the word Itself.

Moreover, recycling wastewater is starting to receive active attention from industry in the context of sustainable development (e.g. protection of the environment, developing concepts of "green chemistry", use of renewable resources), improved water management (recycling of waste water) and also health concerns(Kentish and Stevens 2001; Cox et al. 2007; Sharma and Sanghi 2012; Khalaf 2016 Rathoure and Dhatwalia 2016; Morin-Crini and Crini 2017). Thus, for the industrial world, the treatment of effluents has become a priority.

The composition of waste water is 99.9% water and the remaining 0.1% is what is removed. This 0.1% contains organic matter, microorganisms and inorganic compounds. Wastewater effluents are released to a variety of environments, such as lakes, ponds, streams, rivers, estuaries and oceans. Wastewater also includes storm runoff, as harmful substances wash off roads, parking lots and rooftops.

Often used interchangeably with the term sewage, "sewage" technically denotes any wastewaters which pass through a sewer. Prior to entering a wastewater treatment plant, wastewater is sometimes called raw wastewater or raw sewage

Although the term 'sewage' usually brings toilets to mind, it is used to describe all types of wastewater generated from domestic dwellings. There are two types of sewage: black water, or wastewater from toilets, and gray water, which is wastewater from all domestic sources except toilets. Black water and gray water have different characteristics, but both contain pollutants and disease-causing agents that require treatment.

During the past three decades, several physical, chemical and biological technologies have been reported such as flotation, precipitation, oxidation, solvent extraction, evaporation, carbon adsorption, ion-exchange, membrane filtration electrochemistry, biodegradation, and phytoremediation (Berefield et al. 1982; Liu and Liptak 2000; Henze 2001; Harvey et al. 2002; Chen 2004; Forgacs et al. 2004 ; Anjaneyulu et al. 2005; Crini and Badot 2007; Cox et al. 2007; Hai et al. 2007; Rathoure and Dhatwalia 2016; Morin-Crini and Crini 2017).

Waste water from non-residential sources generally require additional treatment steps than what is needed for sewage. For example, to prevent flooding of treatment plants during bad weather, storm water should be collected separately. Screens often remove rubbish and other large solids from storm sewers. In addition, many industries produce wastewater high in chemical and biological pollutants that can burden treatment systems. Dairy plants and breweries are perfect examples of this. To combat any issues these types of wastewater sources tend to provide their own treatment or preliminary treatment to protect the main wastewater treatment system

Domestic wastewater originates from activities such as restroom usage, bathing, food preparation and laundry. Commercial wastewater from non-domestic sources, such as beauty salons or auto body repair shops, for example. This wastewater may contain hazardous materials and requires special treatment or disposal. Industrial waste water originates from industrial or commercial manufacturing processes, such as agriculture, and are usually more difficult to treat than domestic wastes. Industrial wastewater's composition varies on an industry-by-industry basis.

III. COMPENET THE WASTE WATER:

Wastewater is mostly water by weight. Other materials make up only a small portion of wastewater, but can be present in large enough quantities to endanger public health and the environment. Because practically anything that can be flushed down a toilet, drain, or sewer can be found in wastewater, even domestic sewage contains many potential pollutants. The wastewater components that should be of most concern to homeowners and communities are those that have the potential to cause disease or detrimental environmental effects

Organisms

Many different types of organisms live in wastewater and some are essential contributors to treatment. A variety of bacteria work to break down certain organic pollutants in wastewater by consuming them. Through this process, organisms turn wastes into carbon dioxide and water

Bacteria and other microorganisms are particularly plentiful in wastewater and accomplish a lot of the treatment.

Pathogens

Many disease-causing viruses, parasites, and bacteria also are present in wastewater and can enter from almost anywhere. Likely sources include hospitals, schools, farms, and food processing plants.

Some illnesses from wastewater-related sources are relatively common. Gastroenteritis can result from a variety of pathogens in wastewater, and cases of illnesses caused by *Cryptosporidium* can also occur. Other important wastewater-related diseases include hepatitis A, typhoid, polio, cholera, and dysentery. Outbreaks of these diseases can occur as a result of drinking water from wells polluted by wastewater, eating contaminated fish, or recreational activities in polluted waters.

Organic mater

The organic content of wastewater is made up of human feces, protein, fat, vegetable and sugar material from food preparation, as well as soaps. Some of this organic content is dissolved into the water and some exist as separate particles. The portion of organic material that does not dissolve but remains suspended in the water is known as suspended solids. Wastewater is treated to remove as much organic material as possible Large amounts of biodegradable materials are dangerous to receiving waters such as lakes, streams, and oceans, because organisms use dissolved oxygen in the water to break down the wastes. This can reduce or deplete the supply of oxygen in the water needed by aquatic life, resulting in fish kills, odors, and overall degradation of water quality. The amount of oxygen organisms needed to break down wastes in wastewater is referred to as the biochemical oxygen demand (BOD) and is one of the measurements used to assess overall wastewater strength.

Most wastewater treatment systems are designed to rely in large part on biological processes. There are various sources of water contamination (e.g. households, industry, mines infiltration) but one of the greatest remains its large scale use by industry (Anjaneyulu et al. 2005; Hai et al. 2007). Four categories of water are generally distinguished: (1) rainwater (runoff from impermeable surfaces), (2) domestic wastewater, (3) agricultural water and (4) industrial wastewaters (Crini and Badot 2007). The last group can be subdivided into cooling water, washing effluent (of variable composition), and manufacturing or process water (biodegradable and/or potentially toxic). In general, process waters (i.e. wastewaters or effluents) pose the greatest problems. Wastewaters differ significantly from drinking water sources (usually rivers, lakes, or reservoirs) in one important way: the contaminant levels in most drinking water sources are quite low as compared with contaminant levels in wastewaters derived from industrial-type activities (Cooney 1999). However, their toxicity depends, of course, on their composition, which in turn depends on their industrial origin.

Some organic compounds are more stable than others and cannot be quickly broken down by organisms, posing an additional challenge for treatment. This is true of many synthetic organic compounds developed for agriculture and industry.

Inorganics mater :

Inorganic minerals, metals, and compounds, such as sodium, potassium, calcium, magnesium, copper, lead, nickel, and zinc are common in wastewater from both sewage and wastewater. They can originate from a variety of sources including industrial and commercial sources, storm water, and inflow and infiltration from cracked pipes. Most inorganic substances are relatively stable, and cannot be broken down easily by organisms in wastewater.

Large amounts of many inorganic substances can contaminate soil and water. Some are toxic to animals and humans and may accumulate in the environment. For this reason, extra treatment steps are often required to remove inorganic materials from industrial wastewater sources. For example, heavy metals which are discharged with many types of industrial wastewaters, are difficult to remove by conventional treatment methods.

Pollution issues have a strong impact on the population. Colored effluent, for instance from pulp and paper mills or from textile mills, has a strong visual impact due to its color and is perceived by the public as an indication of the presence of dangerous pollution – however toxic the coloring actually is (Lacorte *et al.* 2003; Pokhrel and Viraraghavan 2004; Forgacs *et al.* 2004; Rana *et al.* 2004; Anjaneyulu *et al.* 2005; Crini 2005; Hai *et al.* 2007; Wojnárovits and Takács 2008). Colored effluent can lead to nature protection associations or other stakeholders in the water bodies suing the parties responsible. In addition, it is known that paper-mill wastewater contains nutrient elements that can lead to eutrophication and thus to a heavy organic load for the aquatic environment due to the proliferation of algae at the expense of other aquatic species (Lacorte *et al.* 2003; Rana *et al.* 2004). Effluent with high levels of heavy metals from surface treatment industries is also a serious source of toxicity for aquatic ecosystems, again creating worries for the population (Rana *et al.* 2004; Anjaneyulu *et al.* 2005; MorinCrini and Crini 2017).

Nutrients

Wastewater often contains large amounts of the nutrients nitrogen and phosphorus in the form of nitrate and phosphate, which promote plant growth. Organisms only require small amounts of nutrients in biological treatment, so there normally is an excess available in treated wastewater. In severe cases, excessive nutrients in receiving waters cause algae and other plants to grow quickly depleting oxygen in the water. Deprived of oxygen, fish and other aquatic life die.

IV. STAGE OF TREATMENT WASTE WATER :

When water is polluted and decontamination becomes necessary, the best purification approach should be chosen to reach the decontamination objectives as established by legislation). A purification process generally consists of five successive steps as described in Fig. 1.1: (1) preliminary treatment or pre-treatment (physical and mechanical); (2) primary treatment (physicochemical and chemical); (3) secondary treatment or purification (chemical & biological) tertiary or final treatment (physical and chemical); and (5) treatment of the sludge; (4) formed (supervised tipping, recycling or incineration). In general, the first two steps are gathered under the notion of pre-treatment or preliminary step, depending on the situation (Anjaneyulu et al. 2005; Crini and Badot 2007, 2010). Pre-treatment consists of eliminating the (floating) solid particles and all suspended substances from the effluent. This pre-treatment stage, which can be carried out using mechanical or physical means is indispensable, before

envisaging secondary treatment because particulate pollution (e.g. SS, colloids, fats, etc.) will hinder later treatment, make it less efficient or damage the decontamination equipment. Primary chemical treatment such as oxidation for cyanide destruction and Cr(VI) reduction, pH adjustment, pre-reduction of a high organic load may also be required. For instance effluent from paper mills contains abundant SS such as fibres, fillers and other solids (Pokhrel and Viraraghavan 2004; Anjaneyulu et al. 2005; Sharma 2015). Effluents from textile mills have a very variable pH although it is often alkaline, containing a high organic load. It is therefore indispensable to pre-treat these effluents before considering secondary treatment. However, these treatments alone are, in many cases, incapable of meeting the legislation requirements

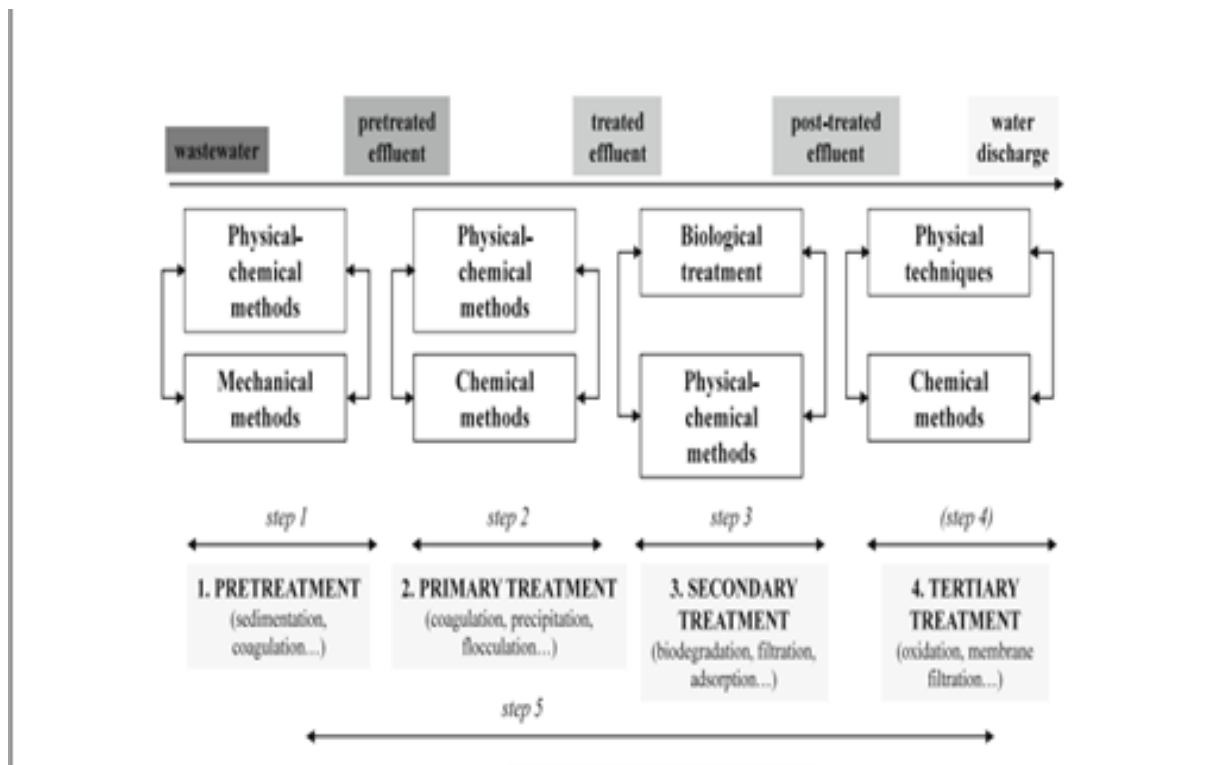


Figure. (1) Overview of the main processes for the decontamination of contaminated industrial wastewaters

Before its discharge into the environment or its reuse, the pre-treated effluent must undergo secondary purification treatment using the most appropriate of the biological, physical or chemical techniques available to remove pollution. In certain cases, a final or tertiary treatment (step 4 in Fig. 1.1) can also require to remove the remaining pollutants or the molecules produced during the even the chemical secondary purification (e.g. the removal of salts produced by the mineralization of organic matter). However, the use of tertiary treatment in Europe is limited, though it may be necessary in the future if new restrictions are applied. The main tertiary treatments employed to date at a few industrial sites are adsorption using activated carbons (AC), ion-exchange, membrane filtration (ultrafiltration, reverse osmosis), advanced oxidation, and constructed wetlands (CW). In Europe, most of the CW are applied for domestic sewage and municipal wastewater treatment. However, the diversity of CW configurations makes them versatile for implementation to treat

Decentralized sewerage system is defined as the collection, treatment, disposal / reuse of sewage from individual homes, clusters of homes, isolated communities or institutional facilities, as well as from portions of existing communities at or near the point of waste generation. Typical situation in which decentralized sewerage management should be considered or selected include

1. Where the operation and maintenance of existing on-site systems must be improved
2. Where individual on-site systems are failing and the community cannot afford the cost of a conventional sewerage management system
3. Where the community or facility is remote from existing sewers
4. Where localized water reuse opportunities are available.
5. Where freshwater for domestic supply is in short supply.
6. Where existing STP capacity is limited and financing is not available for expansion

7. Where, for environmental reasons, the quantity of effluent discharged to the environment must be limited
8. Where the expansion of the existing sewage collection and treatment facilities would involve unnecessary disruption of the community.
9. Where the site or environmental conditions that require further sewage treatment or exportation of sewage are isolated to certain areas.
10. Where residential density is sparse
11. Where regionalization would require political annexation that would be unacceptable to the community
12. Where specific sewage constituents are treated or altered more appropriately at the point of generation

V. MICROBIAL FUEL CELL (MFC) TECHNOLOGY

Recently, the application of MFC technology for the treatment of wastewater with the generation of electricity has been widely reported. MFC is a biochemical device that uses bacteria as a biocatalyst to convert chemical energy present in organic matter e.g. glucose) into electricity (Zhang, T.*et al*,2008, Kim, B. H., 2007). Basically, MFC consists of an anaerobic anode chamber, a cathode chamber and a proton exchange membrane (PEM) or salt bridge which separates both chambers and only permits the transfer of proton (H⁺) from the anode chamber to the cathode chamber. Bacteria gain energy by transferring electrons from its central metabolic system to the anode, which acts as the final electron acceptor in MFC.

The electron is then conducted across an external circuit to the cathode where they combine with oxygen and H⁺ to form water. Currently, both mixed and pure cultures of bacteria have been utilised in MFC to generate electricity

The transfer of electron from bacteria to the anode, known as the (Zhang, T.*et al* Hassan, S. H. A. *et al* ,2012, Rezaei, F., Xing,*et al* D.2009) achieved in three different pathway; (1) direct outer membrane c-type cytochrome transfer, (2) exploitation of electron mediators that are either externally added or produced by the microorganisms themselves, (3) through electrically conductive pili (Topare, N. S., *et al* 2011; Singh, R., Paul, *et al* 2006).

Advantages:

MFC offers several advantages over other energy generating technology from organic matter. These advantages according to Rabaey and Verstraete (Rabaey, K., and Verstraete, W., 2005) include, high energy conversion efficiency due to direct conversion of chemical energy within substrate to electricity, efficient operation at ambient and low temperatures and lack of gas treatment since gases released are rich in CO₂ which have no useful energy content. In addition, aeration is not required since the cathode is aerated passively thus reducing the cost of operation (Liu, H., Ramnarayanan, R., and Logan, B. E., 2004)

Concept Of Decentralized Sewerage :

Decentralized wastewater management is used to treat and dispose, at or near the source relatively small volumes of wastewater, originating from single households or groups of dwellings located in relatively close proximity (indicatively, less than 3–5 km, maximum) and not served by a central sewer system connecting them to a regional wastewater treatment plant (WWTP).

This obviously still needs a local collection system, yet this will likely be much smaller and less expensive than those used for conventional, centralized treatment, especially when the grey water components have been separated from the black flow as discussed in a later section (Parkinson, J. *et al*,2003; Chen, R.; Wang, X.C ,2009). The term decentralized also qualifies systems serving small portions (clusters) of an urban area according to hydrology, landscape, and local ecology considerations. Sustainable decentralized sanitation focuses on the on-site treatment of wastewater and local recycling and reuse of resources contained in domestic wastewater (in primis, water itself). It has been claimed that decentralized treatment systems favor water recycling and reuse in proximity of their location (Opher, T.; Friedler, E.,2016) Other resources that can be readily recycled are: bio-energy (mostly from organic material transformation, even though attempts are being made to recover water-embedded residual heat), and nutrients (mainly nitrogen and phosphorus) (Van Loosdrecht, M.C.M.2016). Also, in these cases local reuse of recovered components helps to form closed loops” of resources uses, in line with the principles of “circular economy”. To reduce use and wastage of resources, typical of a “once-through” resource use, the “closed loop” concept was introduced, whereby system resources, energy, and materials are re-used multiple times (even if for different purposes) with minimum processing required by each subsequent use. The “circular economy” is a new global economic paradigm that, looking beyond the current “take, make, and dispose” mode, is designed to be restorative and regenerative and, relying on system-wide innovation aims to redefine products and services to

eliminate waste, while minimizing negative impacts The “closed loop” can therefore be viewed as a local version of circular economy for details, refer to (www.ellenmacarthurfoundation.org/circular-economy and local resources valorization). Although conventional” technologies may as well be applied (at a reduced scale), to decentralized systems too real advantages from such an approach in terms of energy savings (or even recovery) achievement of

resources recovery and recycling, and functional process integration, will derive from the adoption of new, more sustainable process technologies, as will be illustrated henceforth It should be remembered that the two main historical objectives of wastewater management systems are: to protect and promote human health (by providing a clean environment and breaking the cycle of disease), and to provide water quality and ecosystems protection (by avoiding negative effects of excessive pollutants discharge into the environment (Novotny, V.*et al*,1989). The “most appropriate technology in any situation is the one that turns out to be economically affordable, environmentally protective technically and institutionally consistent, and socially acceptable for the specific application—in other words, one that is sustainable, according to all viewpoints. As an additional bouns, decentralized systems are generally compact, with highly flexible operating conditions and reduced aesthetic impact however, other local impacts (i.e., odors, traffic) should be considered (Capodaglio, A.G.;*et al*,2002, Torretta, V.; *et al* 2016) ,even though some may appear obvious projects have failed due to planners’ lack of consideration. As an example, Beijing (China), a city that is suffering from a severe water deficit (3.6) billion m³/y water consumption, far in excess of the 2.1 billion m³/y locally available) (Beijing Water Authority (BWA),2014, Wang, G.S.; Xia, J.2005) recently passed a building code requiring large buildings to internally recycle grey water for toilet flushing. The provision, however, is still largely unattended as residents find this use objectionable and uneconomical (in fact, it costs less to buy water from the public network than to operate the treatment units already installed for reuse), save for a few university buildings where this policy’s acceptance was obtained from mostly young student residents (Wang, G.S.; Xia, J. 2005) It is clear from the Table below that different requirements were unaccounted for in this case: social acceptance, financial, and planning technological.

Generally speaking, decentralized systems require more awareness, involvement, and participation from local users than centralized ones. The decision to implement a decentralized solution to wastewater treatment needs is usually made or discussed at the local level and local stakeholders are usually more proactive when considering these systems (US EPA, 2005). They may be very well accepted when their objectives and advantages (including economical ones) have been clearly illustrated to users, as frequently happens with other environment-related projects (Capodaglio,*et al* ,2016]. In a few EU countries (Germany, The Netherlands) demonstrative decentralized systems serving up to 1000 people have been implemented in urban areas (examples: Knittlingen and Jenfelder Au, Sneek), incorporating reuse of water, energy, and resources, and receiving vast support by residents (Tervahauta, T.; *et al*,2013, Mueller, R.A. 2014) A recent study by Suriyachan et al. (Suriyachan, C.; et al ,2012) examined three cases in the city of Bangkok, using case study research methods to evaluate the potential of centralized and decentralized wastewater management approaches for urban development. The results showed that decentralized management proved economically and technically efficient, and conducive to sustainable urban development in the application area. Decentralization showed a competitive cost structure (as result of shorter) sewer lines), simpler technology, and limited additional costs, while high efficiency could be achieved with good operation and maintenance (O & M). Locally reclaimed water was largely (30–100%) used for landscape irrigation of green areas, while in centralized systems less than 5% of the effluent was recycled. In addition to the financial aspect, sustainability of such systems was shown to lie in the social value of the public amenities they provide, and in the implication that they driver for smart growth. No conflicts were observed in the study with sustainable urban development,could be an additional even in the innermost, more densely populated urban areas In traditional systems, household discharge streams are combined and transported by an extended sewer system to a (possibly) far away, centralized WWTP. Collection and treatment of wastewater with a centralized approach often requires more pumps, longer and bigger pipes, and more energy than decentralized ones, increasing the infrastructure cost of the system (Go, E.; Demir, I., 2006). About 80–90% of capital costs in such systems can be related to the collection system itself, with some possible economy of scale in the most densely populated areas (Maurer, M.;2005).

An argument often brought up by supporters of centralized systems is that wastewater treatment cost per unit volume in such systems is more competitive (due to economies-of-scale) compared to decentralization. This is partly true—where a wastewater collection system already exists; however, it is estimated that any collection system (as a whole or parts of it needs to be more or less completely renewed every 50–70 years, besides the required continuing maintenance (Maurer, M.;2005). Also, in case of new/refurbished systems, it is often found that the initial flow received is much less (50–80%) than the design flow (calculated for a planning horizon of 30

or more years) for a considerable amount of time. This means that, save for some countries with extremely fast urbanization rates (e.g., India, Middle East), a centralized system could have substantial idle capacity that remains such until demand grows into it, paying money in advance for future scenarios that may not develop and potentially stopping more urgent investments elsewhere (Wang, S., 2014). Decentralized systems, on the contrary, use a more cost-effective 'pay-as-you-go' (or 'just-in-time') approach in which capacity can be added incrementally and quickly (Maurer, M.; *et al* ,2010). In case of large block redevelopment in metropolitan areas with centralized sewage collection systems, a paradigmatic switch may therefore be worthy of consideration.

The following sections will analyze wastewater treatment and collection/conveyance technologies respectively, with special consideration of their applicability in decentralized systems and technological ecological, and economical sustainability.

Modern challenges in waste water treatment in the 21st century :

Collection and treatment of urban waste water is essential to protect human health and the environment

Across Europe, urban waste water treatment plants address widely varying conditions, such as the different substances in sewage, the size of the population being served, the requirements of the receiving waters and the local climate

Much has been done to provide collection and treatment of urban waste water, but new pressures such as adapting to climate change, providing facilities in urban and rural areas, and tackling newly identified pollutants all require substantial investment in addition to maintaining existing infrastructure

Energy costs and scarce resources should be reasons to promote water efficiency. They also provide opportunities for urban waste water treatment to contribute more to the circular economy, for example, through energy generation, water reuse and materials recycling

Urban waste water treatment

For most European citizens, sewage from our toilets, sinks and washing machines goes down pipes to be treated, reducing disease-causing organisms and the nutrient load that would otherwise cause pollution and the proliferation of algae

Waste water from households and industry creates significant pressure on the aquatic environment because of the loads of organic matter and nutrients it contains. If released into water ways, ammonia and natural processes break down organic matter in the water but can use up the oxygen, making the river uninhabitable for fish and invertebrates. Meanwhile, excess nutrients, such as nitrogen and phosphorus, can cause plants and algae to grow excessively, cutting out light and using up the oxygen in the water through respiration or when the plants decay (Picture 1).



Excess nutrients cause plants and algae to grow excessively Picture (1):

The widespread introduction of effective waste water treatment during the 20th century has greatly improved human health and environmental quality.

The proportion of households connected to waste water treatment facilities varies across Europe. In western-central Europe, for example, the connection rate is 97 %. In southern, south-eastern and eastern European countries, it is generally lower, although it has increased over the last 10 years to reach about 70 % (EEA, 2017a). Despite these significant improvements in recent years, around 30 million people are still not connected to waste water treatment plants in Europe. In areas where people live far apart, it may be more practical to use individual treatment methods like septic tanks to deal with sewage

How does urban waste water treatment work?

Sewers need to be built to collect sewage and transport it to a waste water treatment plant. There, differing levels of treatment can be applied and usually include

Pre-treatment, which physically removes large objects like rags and plastics, and smaller objects like grit from the waste water. This prevents damage to the equipment further along the treatment process

Primary treatment, which removes fine particles. Waste water is held in a tank where heavier solids can settle to the bottom, while any lighter solids and fat float to the surface. The settled and floating materials are separated, while the remaining liquid proceeds to secondary treatment or is discharged to the environment

Secondary treatment, also known as biological treatment, removes the remaining organic matter, suspended solids and some of the bacteria, viruses and parasites, and to some extent nutrients and chemical substances

More stringent treatment is applied to remove the remaining nutrients when discharging into sensitive waters. Specific treatment techniques, such as disinfection, can be used to further remove bacteria, viruses and parasites harmful to public health, or any remaining chemicals and harmful substances

More information about treatment types in specific urban waste water treatment plants is available: EEA urban waste water treatment maps

Sludge management

Sewage sludge, formed by bacteria as a result of the consumption of organic pollution, arises as a by-product of waste water treatment. A range of treatments allow the safe disposal of the sludge. Liming and aerobic or anaerobic digestion stabilise the sludge, avoiding odour and reducing pathogenic organisms. Anaerobic digestion reduces the amount of sludge and produces biogas, while dewatering removes excess water, decreasing the weight and reducing transportation costs.

Different disposal routes exist, depending mostly on national regulatory frameworks and sludge quality. Approximately half the sewage sludge produced by EU Member States is spread on land as fertiliser and a quarter is incinerated (Eureau, 2017). Sludge can contain high concentrations of metals, pathogens and persistent trace organic pollutants, so its use on land may be restricted to protect the environment.

Challenges for the 21st century

Past decades have seen billions of euros invested across Europe in the collection and treatment of urban waste water to remove harmful microorganisms, oxygen-consuming substances and nutrients (EC, 2017). This investment means that most Europeans no longer need to worry about the quality of their drinking water or local waterways (EEA, 2016, 2017b). However, our understanding of the challenges faced by urban waste water treatment has improved, for instance, in our knowledge of climate change and of the presence of hazardous substances. As we address these, we can use the opportunity to implement more sustainable solutions (Fig)

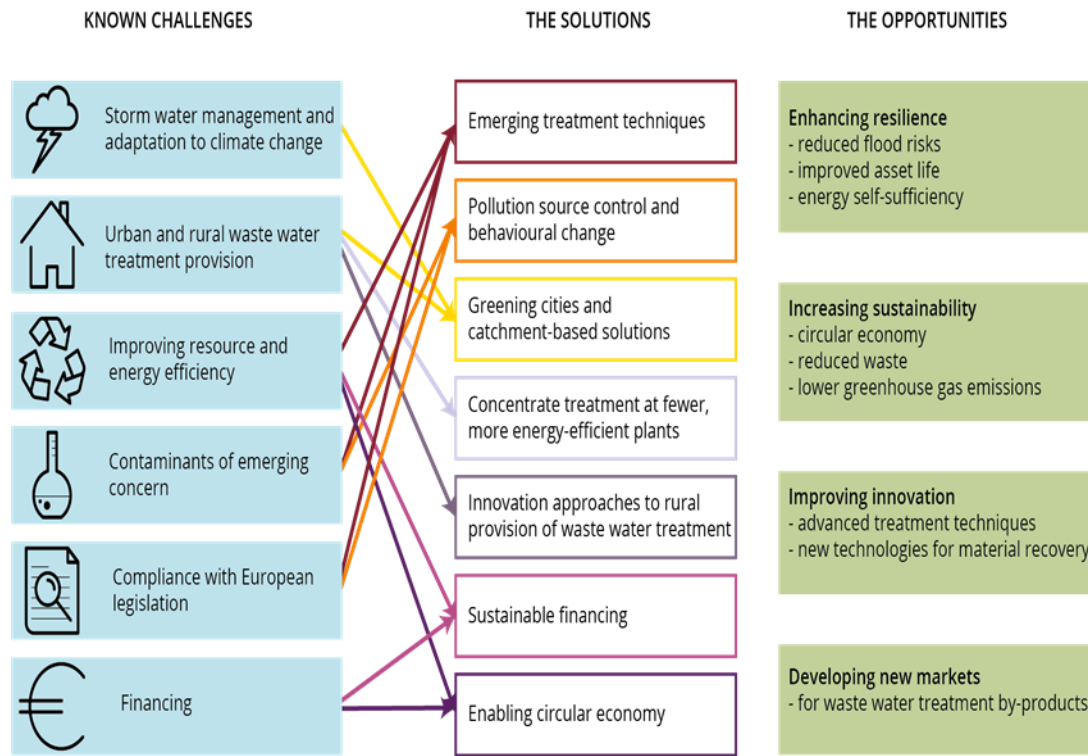


Figure (2) :Challenges, solutions and opportunities for urban waste water treatment plants

Storm water management and adaptation to climate change

In some areas, climate change means heavy rainfall will be more frequent. In urban areas — where rainwater drains into the sewers carrying domestic sewage and industrial waste water (so-called ‘combined sewers’) — the rain enters the combined sewer network faster than it was designed for. This can cause overloading of the sewer network, leading to surface water flooding and overflow at urban waste water treatment plants, with untreated sewage flowing into rivers, lakes or coastal areas. Sustainable urban drainage systems can provide a solution, as they are designed to manage runoff in a sustainable way

In other areas, climate change will lead to reduced rainfall. As a first step, improving water efficiency to reduce unnecessary use can conserve both water and the energy used in its transport and treatment. However, waste water treatment itself can play an important role in increasing the water availability. High level treatment can remove pollutants, so that the treated water can be reused. The EU is, in 2019, preparing a regulation on the reuse of urban waste water for agricultural irrigation

Table (1) : One of the level from modern treatment to waste water

The challenge	Solutions implemented by countries
Storm water management: adapting to climate change	Waste water treatment plants in Malmö, Sweden, discharge to coastal areas. An open storm water system designed to accommodate a 15-year rainfall event includes 6 km of canals and water channels, 10 retention ponds, 30 green roofs and a botanical roof garden on an old, industrial roof. Rainfall is collected in natural ditches and reservoirs before being directed into a conventional sewer system. The system is integrated within green spaces that can be temporarily flooded to help manage water by slowing its entry into the conventional storm water system. This system avoids energy use by diverting storm water away from collection systems and waste water treatment.
Seasonal increases in population and water scarcity	In Malta, the Ta’Bakrat urban waste water treatment plant serves 434 000 population equivalent (p.e.), treating approximately 80 % of all waste water in Malta. It is subject to particular pressures during the tourist season. Investment in treatment technology

	helps address the issue of water scarcity, as the installation aims to provide 7 billion litres of reclaimed water for agricultural irrigation and aquifer recharge each year. New treatment construction costs EUR 20 million, with a further EUR 20 million invested in irrigation infrastructure
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Urban and rural waste water treatment provision

In urban areas it can be a challenge to find space to install new treatment plants or upgrade existing ones. There can be public opposition to development near residential areas, owing to noise and odour concerns

In rural areas, population densities, the nature of the ground and surface water characteristics are key to deciding the type of collection and treatment system needed. Individual treatment systems, like septic tanks, are often used, since investment in sewers and treatment is generally costly and may impact heavily on a few users. The treatment plant needs to be able to operate with low volumes of water. Moreover, it can be difficult to find suitably qualified personnel to operate the treatment plant

Table (2): second of the level from modern treatment to waste water

The challenge	Solutions implemented by countries
Small, rural area with seasonal increase in population	The Rowy treatment plant in Poland deals with urban waste water from 5 000 p.e in winter and three times as much in the summer. It discharges directly into the Łupawy river. With increasing numbers of tourists, the plant was upgraded to increase capacity and introduce more efficient technologies. It was rebuilt to operate in two modes: part operation in ‘winter’ mode when there is less waste water to process; and full operation in ‘summer’ mode to deal with higher quantities of waste water. The upgrade cost approximately €7.5 million, with energy savings recorded in the winter.

Improving resource and energy efficiency

In recent years, efforts have been put in place to reduce the energy consumption of infrastructure. Many urban waste water treatment plants have invested in technologies to better control processes and use less electricity, with non-CO2 greenhouse gas emissions decreasing by 20% between 2005 and 2017 (EEA, 2019a). The capture of biogas resulting from the processes and the implementation of anaerobic digestion can be used to support the plants’ energy needs. Energy efficiency measures include the recovery of heat from waste water processes and the use of space to accommodate wind turbines and solar panels, providing renewable energy

Table (3): third of the level from modern treatment to waste water

The challenge	Solutions implemented by countries
Improving resource and energy efficiency	In the Netherlands, the Amersfoort urban waste water treatment plant (315 000 p.e.), receives domestic and light industrial effluent. The treatment process comprises physical treatment, and carbon, nitrogen and phosphorus removal. The final effluent is discharged to the River Eem. In 2016, Amersfoort was converted into a regional sludge processing hub for several waste water treatment plants in the area, supported by the EU LIFE programme (with EUR 10.5 million). It uses innovative technologies to recover phosphorus and nitrogen from sludge for commercial nutrient use, producing a fertiliser as well as biogas. It is 100 % energy self-sufficient and exports energy to power

Discharge into sensitive areas — compliance with European legislation

In some cases, where the receiving water is particularly sensitive, treated effluent must meet a very high standard. This is done, for instance to avoid nutrients that cause excessive algal growth when discharged into Nutrient

Sensitive Areas under the Water Framework Directive; to kill pathogens if discharge is near bathing waters; upstream of drinking water abstraction; or in watercourses with European or international protection.

Table (4): third of the level from modern treatment to waste water

The challenge	Solutions implemented by countries
Discharge into sensitive area and provision for broader infrastructure	The Arad urban waste water treatment plant in Romania has a treatment capacity of 225 000 p.e. It discharges effluent into a highly sensitive stretch of the Mures River, designated a Special Protection Area for birds and a Nutrient Sensitive Area. Upgrades to seven treatment plants — co-financed by the EU Cohesion Fund — rehabilitated the plants, as well as reservoirs, water transmission pipes and the sewerage network. The waste water treatment plant upgrade cost EUR 18 million. This resulted in a significant reduction in the organic and nutrient pollution load entering the River Mures.
Protection of drinking water aquifer	The Wulpen urban waste water treatment plant in Belgium has a capacity of 74 700 p.e. The aquifer of St-André needed to be protected from saline intrusion as a result of over-abstraction. The upgraded plant includes more stringent treatments to remove phosphorus and disinfect the effluent. The treated water is of superior quality — similar to that of drinking water — is free of micropollutants and pathogens, and is used to recharge the aquifer. The project cost EUR 6 million and was financed by the EU's 7th Framework Programme.

Issues of emerging concern

In recent years, concern has increased regarding the presence of many chemicals at low concentrations within the water environment. With so many different substances in use, many chemicals reach surface waters via urban waste water treatment plants applying traditional treatment methods. Research has shown that many of the chemicals in waste waters now arise from use in our homes and leaching from products, or are directly added in the case of cleaning products and excreted pharmaceuticals (UKWIR, 2018). Concern is growing over the presence of mixtures of chemicals in the environment — the so-called ‘cocktail effect’ — that may be impacting aquatic life (EEA, 2019b).

An example of a possible new concern is antimicrobial resistance (AMR), which arises from the use of antimicrobials, such as antibiotics, in human and veterinary medicine. Use and excretion of antimicrobial agents has resulted in the evolution of resistant bacteria, viruses and microbes, which can cause disease and are now resisting medicinal treatment. As a consequence, it has become increasingly difficult to tackle certain infections (WHO, 2018). Urban waste water treatment plants could be transferring AMR genes to the environment, but currently there is very limited information on the pathways for AMR in the environment to reach humans and the significance of this (EEA, 2019c).

Continued vigilance will be needed to tackle new issues for waste water treatment as they are identified.

European legislation

In the EU, the main objective of the Urban Waste Water Treatment Directive (91/271/EEC) and equivalent national legislation for non-EU countries, is to protect the environment from the adverse effects of waste water discharges. This is achieved through the collection and treatment of waste water in settlements and areas of economic activity with a p.e. of more than 2 000. In most cases, the Directive sets out that waste water must be subject to secondary treatment but in catchments with particularly sensitive waters, more stringent waste water treatment may be required. Currently the European Commission is evaluating the Directive to see if works well and is adequate for current and newer issues.

The Water Framework Directive (2000/60/EC) established a framework for the protection of rivers, lakes, transitional waters (estuaries), coastal waters and ground water. It aims to ensure that all surface water bodies are

at good chemical and ecological status, displaying minimal signs of impact from human development. Meeting the requirements of the Urban Waste Water Treatment Directive is the baseline for water pollution coming from urban areas

Biofilm technology

Definition of biofilm itself is simply defined as communities or clusters of microorganisms that attached to a surface (O'Toole. *et al* 2000, Singh, R.*et al* 2006) Formation of biofilm could be

achieved by a single or multispecies of microorganisms that have the ability to form at biotic and abiotic surfaces (O'Toole. *et al* 2000)

As a general, there are few steps that important for development of biofilm, which

starting with the initial attachment and establishment to the surface, followed by

maturation, and finally, the detachment of cells from surface (O'Toole. *et al* 2000, Watnick, *et al* 2000).

According to Watnick and Kolter (Watnick, *et al* 2000), the formation of a bacterial biofilm is a sa with community that is built by human. First, the bacterium must approaches closely before form a transient attachment with the surface and/or other microorganisms that me formerly attached to the surface. This step of transient attachment allows the to search a place before adapting it. After the bacterium has finally settled down, it will form a stable attachment and associate into a microcolony, which is the bacterium has chosen the neighbourhood to live.

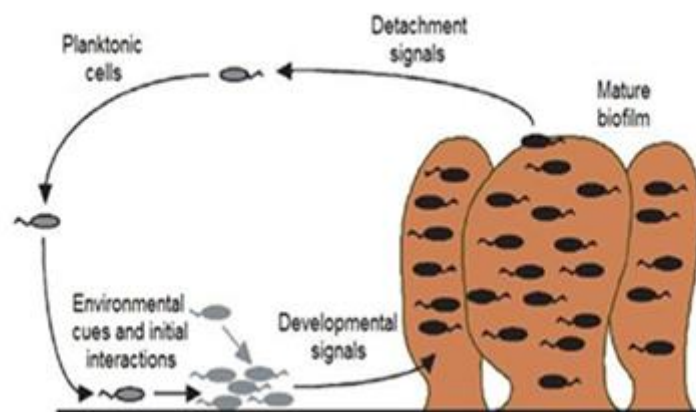


Figure (5): Process of biofilm development

Finally, the building of biofilm is established and irregularly, the biofilm-associated bacteria will detach from biofilm surface. The uses of biological treatment process have taken into placed compared to physical and chemical method in terms of their efficiency and economy (Paul, D.,*et al*, 2005). One of the biological methods that have been realised to overcome the problems is biofilm. According to Decho (Decho, A.W., 2000), biofilm-mediated bioremediation bioremediation. problems is biofilm. hands a capability and safer option to bioremediation with planktonic microorganisms

The reason behind this is because the cells in a biofilm have a high potentially to survive and adapt towards the process as they are protected by the matrices. Moreover microbial consortium in the form of biofilm has the ability to decolourise and metabolise dyes since there are intrinsic cellular mechanisms that will bring about the degradation or biosorption of dyestuffs (Watnick, et al 2000).

Biofilm offers a proficient and harmless option to bioremediation with planktonic microorganisms since the cells in biofilm have a highly chance of adaptation and survival, particularly in unfavourable conditions. This situation is due to the matrix that actually acts as a barrier and protects the cells within it from environmental distress (E Decho, A.W., 2000) xtracellular polymeric substances or EPS have significant towards growth of biofilm which it

appears that to be a part of protective mechanism for the biofilm community. (Wingender *et al.*, 1999) reported that EPS can minimise the impact of modification in pH, temperature, and concentration of toxic substances. Biofilm can have very long biomass residence times when treatment requires slow growing organisms with poor biomass yield or when the concentration of wastewater is too low to sustain growth of activated sludge flocs (Wilderer, P.A., *et al* 2001).

Application in wastewater treatment

Biofilm has become an interesting subject to be explored, especially in the perspective of wastewater treatment, therefore, many studies have been performed in order to achieve and gain understanding towards the utilisation of biofilm to remediate the environment. Aerobic fluidised bed reactor, rotating biological contactors, aerobic membrane bioreactor are a few applications of biofilm reactors that have been invented to treat various conditions of wastewater produced by the industrial

VI. CONCLUSIONS:

This paper is a review of the application of some technology for the treatment of wastewater. The treatment modern of their advantages, applications and limitations have been discussed thoroughly. The ultimate goal of the wastewater treatment is the protection of the environment in a manner commensurate with public health and socio-economic concerns. Understanding the nature of wastewater is fundamental to design an appropriate treatment technology in order to ensure the safety, efficacy and the quality of the treated wastewater. Further, improved public education to ensure awareness of the technology and its benefits, both environmental and economic, is recommended

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