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WATER LIVING FROM HOSPITALS AND SPECIFIC POLLUTANTS

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Summary: *This paper explores pollutants from hospitals, the risk to the environment, and the cause of bacteria.*
Another problem to be analyzed is the contamination of domestic wastewater by pharmaceutical products naturally eliminated by patients.

Key words: *pollutants, bacteria, pharmaceuticals, carbamazepine.*

1. Introduction

More and more pharmaceuticals are detected in surface waters in several European countries, thus producing negative effects on human health and aquatic organisms. The effluents from hospitals are eliminated in the outer sewer. Wastewater is required to be chlorinated before it spills into the municipal network. A wide variety of chemicals are commonly used in hospitals for laboratory, research, especially in surgery.

The use of the amount of pharmaceuticals may vary over time from various causes. Changes in the quantity and quality of medicines occur annually due to changes in legislation or the introduction of new pharmaceutical ingredients.

2. Pollutants (Emerging Contaminants) Coming From Hospitals

The type and amount of hospital wastewater pharmaceuticals reflects the substances and quantities of particular drugs that are administered there. In the case of external patients, non-metabolised excretion will occur partly within the hospital elsewhere, depending on the specific therapy and time spent in the hospital.

For example, cytostatics are administered in high percentages in outpatient treatment settings, but relevant amounts of these can also be found in hospital wastewater treatment plants used in magnetic resonance imaging (MRI), which are excreted 90% in during the hospital session [1]. For total invasive anesthesia, alkylphenol compounds are most commonly used, especially propofol. They are characterized by a high excretion rate, on average 90% [1]. Disinfectants are used in large quantities for disinfecting surfaces, instruments and leather, glue production, and the use and processing of food. These are often very complex products or mixtures of active substances: alcohols and

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aldehydes, as well as chlorine-containing compounds such as recalcitrant chlorophenols that are used as active compounds. Solutions containing glutaraldehyde are still used in some hospital departments when disinfecting endoscopes with reusable optical fibers, however, there is generally a tendency to replace it with other compounds with a lower impact on the environment.The major heavy metals found in hospital wastewater are platinum due to excretions by cisplatin-treated oncology patients and carboplatin or other cytotoxic agents. Mercury, usually found in diagnostic agents, active ingredients of disinfectants, as well as in diuretics and gadolinium, which is used in NMR due to a large magnetic field. ICMs exhibit high biochemical stability and are therefore mainly excreted unchanged (over 90%). They come from Xray examinations and radiological practices and, therefore, their appearance increases on working days [1].Finally, adsorbed organic compounds (commonly referred to as AOX) are the compounds that are most persistent in the environment and tend to accumulate in the food chain; they are often toxic to humans and aquatic organisms. Some pharmaceuticals and their metabolites may contain organically bound halogens and may therefore contribute to AOX emissions. In clinical wastewater, the main contributors to the total AOX load are ICM. Furthermore, the release of solvents used in laboratories, disinfectants, cleaning products and chlorine-containing medicines contributes to the destruction of viruses and bacteria [1]. The effects of pharmaceutical manufacture are also a potential concern in releasing a significant burden in the aquatic environment [4], although the mixture of compounds in hospital effluents is likely to be more extensive but with lower concentration levels. Toxicity studies have highlighted the potential toxic effects of entry of effluents from the hospital into the aquatic environment [4], and drug-resistant bacteria are also observed [1,2,4]

Major classes of compounds used in hospitals Table 1 [1].

Class	Example
Antibiotics	Cefazolin, chlortetracycline, ciprofloxacin, ciprofloxacin, doxycycline, erythromycin, lincomycin, norfloxacin, ofloxacin, oxytetracycline, penicillin, sulfamethoxazole, tetracycline, trimethoprim
Analgesics and inflammatory	Codeine, diclofenac, dipyrone, ibuprofen, indomethacin, ketoprofen, mefenamic acid, naproxen, paracetamol, propiphenazone, salicylic acid acid
Cytostatics	5 Fluorouracil, ifosfamide
Anesthetics	Propofol
Disinfectants	Triclosan, glutaraldehyde
Heavy metals	Platinum, mercury
Iodine Contrast Media (ICM)	Iopromid, iopamidol

3. Metabolism

After administration, some pharmaceuticals are not completely metabolised.

Unchanged basic metabolites and other metabolites are then excreted from the body via urine and faeces. In sewage sites, these wastewaters enter sewage treatment plants via waste water.

Carbamazepine is used to treat seizure disorders, improve neuralgia, and for a wide variety of mental disorders. Approximately 72% of oral carbamazepine is absorbed, while 28% is unchanged and subsequently released by faeces [3]. After being absorbed, carbamazepine is heavily metabolised by the liver: only about 1% of the dose leaves the body in an unmodified form. The metabolites of this drug undergo the enterohepatic cycle and, ultimately, it is excreted in the urine.

The elimination time of carbamazepine is dose-dependent, but is usually in the range of 25-65 hours after dosing. Its major metabolites in urine are 10,11-dihydro-10,11-epoxycarbazepine (CBZ-epoxide) and trans-10,11-dihydro-10,11 dihydroxycarbamaze-pine (CBZ-diol) [1, 2, 3]

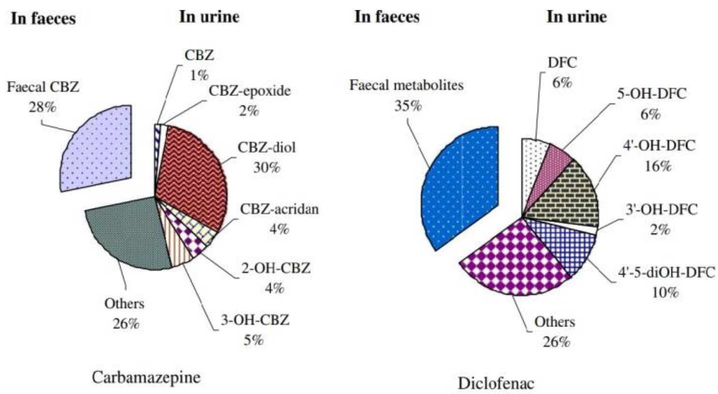

Fig.1. *The identified metabolites of carbamazepine and diclofenac and their oral dosage [3].*

4. Environmental Risk Analysis

Potentially dangerous loads are generally unloaded directly into the public sewerage network and transported for co-treatment to the nearest sewage treatment plant. However, a wide range of concentrations of dangerous substances may be present in the effluent of the hospital.

Waste water consists of the effluent of various services: kitchen, domestic heating and cooling systems, laboratories, radiology departments, outpatient departments, transfusion centers and transfusion sections.

In addition, it is appreciated that antibiotics are one of the most critical therapeutic classes used in hospitals, being extremely resistant to degradation and elimination; indeed, the same 4 antibiotics whose concentrations have high risks in hospital effluents have been encountered at high levels of potential toxicity in the effluent and effluent of the treatment plant. This confirms that conventional treatments operated by treatment plants are unable to effectively remove these pollutants, being built and subsequently upgraded, with the aim of eliminating carbon, nitrogen and phosphorus compounds, pollutants that regularly reach waste water treatment plant in concentrations in the order of mg / l.

This highlights the need for proper and specific management of hospital effluent on a local scale and is still necessary, with research needed to identify the best management strategies, the type of effluent and the evaluation of the most appropriate technologies to remove the most persistent contaminants, thus reducing the possible risk to the environment and human health by contamination with these substances [4, 5, 6].

5 The Appearance of Legionella Bacteria in Hospital Waters

The natural habitat of these organisms is water, they are spread in institutional water systems. Studies by various hospitals have found that up to 70% of the water supply to hospitals in some areas are contaminated with Legionella.

Appearance and survival

The environment in which legionella develops best is water in natural or artificial reservoirs. It can develop and appear in domestic water when its temperature is between 35 and 46 ° C.

There are several types of Legionella prevention treatments, namely: heating> 66 ° C, chlorination, ultraviolet sterilization, ozonation.

Depending on the possibilities available, one or more treatments against Legionella may be chosen. To ensure that Legionella does not get infected, you can use a water filter with ultrafiltration. There are water filters with ultrafiltration, for consumption, and shower filters [7, 8,].

6. The Appearance of E-coli Bacteria in Hospital Waters

The emergence and dissemination of antimicrobial resistance are well established as clinical problems that affect human and animal health. Escherichia coli is an important element of human and animal intestinal flora and pathogen significantly associated with gastrointestinal infection, urinary tract infections and a variety of other extraintestinal infections.

E-sheets poured into the environment can survive significant periods. Detection of E-coli in water and food is widely used as a microbiological indication of contamination fecal matter.

E-sheets can be removed by filtration with ceramic filters or ultrafiltration, using an ultraviolet sterilizer and chlorination. For a 100% safe outcome, more treatment technologies will be used, namely chlorination, UV disinfection and filtration (microfiltration, ultrafiltration or reverse osmosis) [9, 10].

7. Typical Wastewater Treatment

At the moment disinfection and sterilization of wastewater in hospitals is done by chemical or physical processes. Currently, chlorine treatment is applied by introducing chlorine chlorine doses or solid chlorine compounds, which in contact with the wastewater produces chlorine in water.

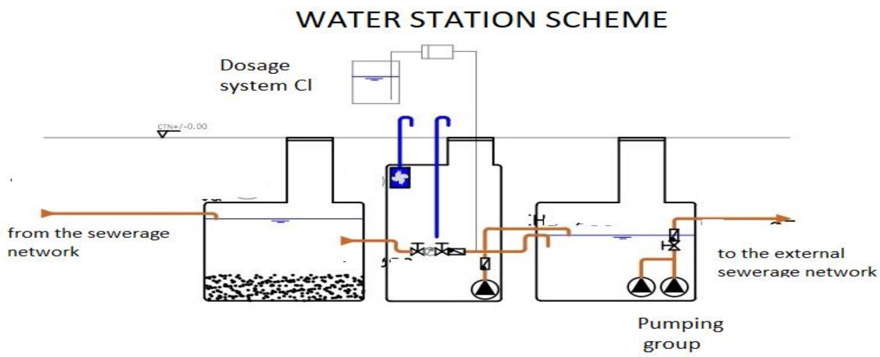

Fig. 2. *Local Waste Treatment Scheme at the Hospital*

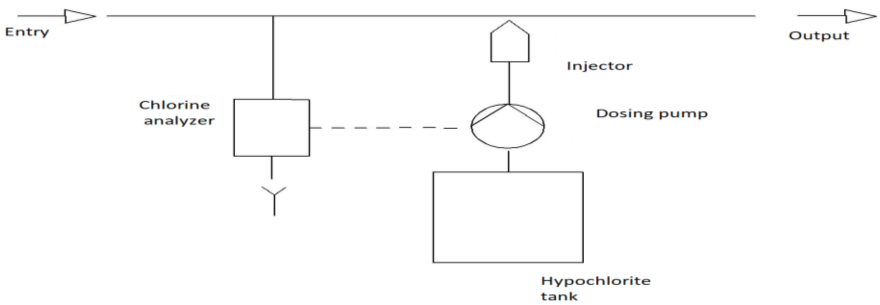

Fig. 3. *Chlorination station on sewerage network from Hospitals*

According to Order no. 1096/2016 the sewage treatment plant in hospitals must have an efficient technology that allows the removal of bacteria in a percentage of 90%. The secondary effluent will probably contain at least 20 mg / l of organic matter in suspension, which is too high for chlorinated disinfection to be effective. Chlorine can remove an amount of antibiotics from the wastewater, but it depends on the amount of chlorine in the water and the reaction time.

When using free chlorine at 1.0 mg / l (Cl2), a 90% elimination was reported with a contact time of more than 16 minutes for most sulfonamides and more than 40 minutes for trimethoprim in river waters [11].

With a free chlorine concentration of 1.2 mg / l for each antibiotic in drinking water, there is a reduction of> 99% for tetracyclines, 50% to 80% for sulfonamides, 42% for trimethoprim, 30% 40% for fluoroquinolones and less than 10% for macrolides, respectively.With a higher concentration of free chlorine, ie between 3.5-3.8 mg / l, there is a 90% elimination and up to> 99% for sulfamethoxazole, trimethoprim and erythromycin after 24 hours - contact time [11].

For these reasons, a new technology should be chosen for the treatment of hospital wastewater, or it would be necessary to improve existing ones.

Bioreactor membrane technology presents a more efficient system for eliminating pathological microorganisms compared to existing wastewater treatment systems. The bioreactor membrane can effectively save disinfectant consumption, shorten the reaction time and achieve an optimal effect of inactivating micro-organisms.

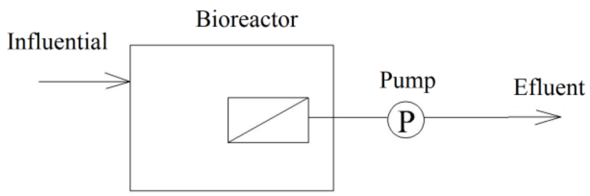

Fig. 4. *Submersible membrane bioreactor [12]*

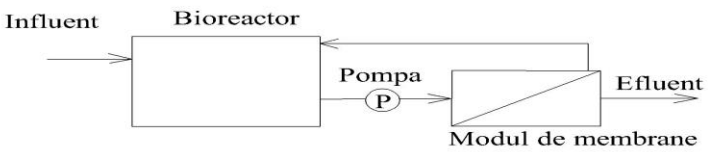

Fig. 5. *Transverse Membrane Bioreactor [12]*

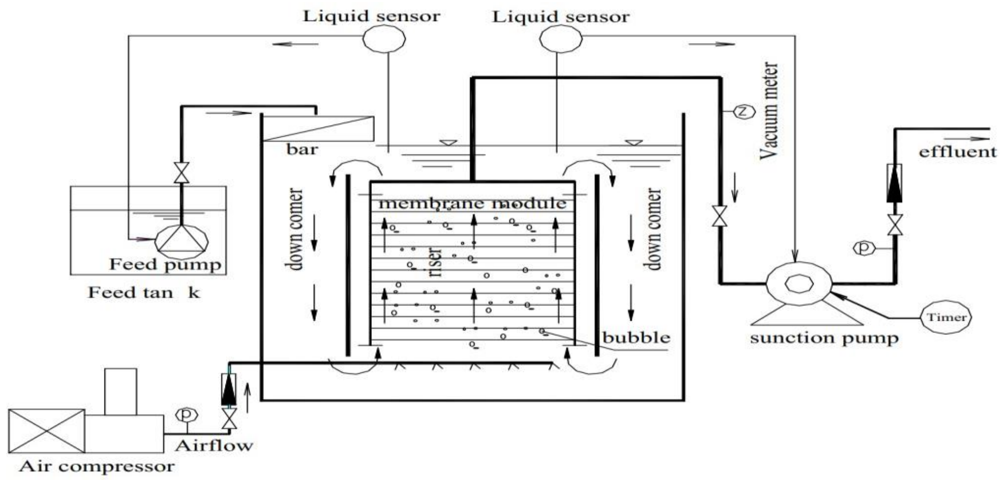

Fig. 6. *Bioreactor scheme with large-scale submersible membranes in community hospital Haidian [13]*

In recent years, membrane bioreactors have received increased attention due to their advantages in treating water and wastewater. Sumerable bioreactors remove solids from the effluent, disinfect effluents, increase loading speed and ensure low mud production / reduce it to zero, etc.

In 99% rejection of some RO membranes and some NF membranes for antibiotics including fluoroquinolones, sulfonamides, tetracyclines and trimethoprim is achieved.

There has been a study on the treatment of a very high initial concentration of oxytetracycline in waste water in the pharmaceutical industry [11].

8. Conclusion

Hospitals are important punctual sources that contribute to the release of both antibiotics and antibiotic-resistant genes in surface water, especially if the wastewater in hospitals is discharged into receiving environment waters without pre-treatment. Therefore, due to the lack of municipal wastewater treatment plants, the treatment of hospital wastewater before discharge into the sewers should be considered a viable and safe option and, therefore, sewage treatment installations local or pre-treatment.

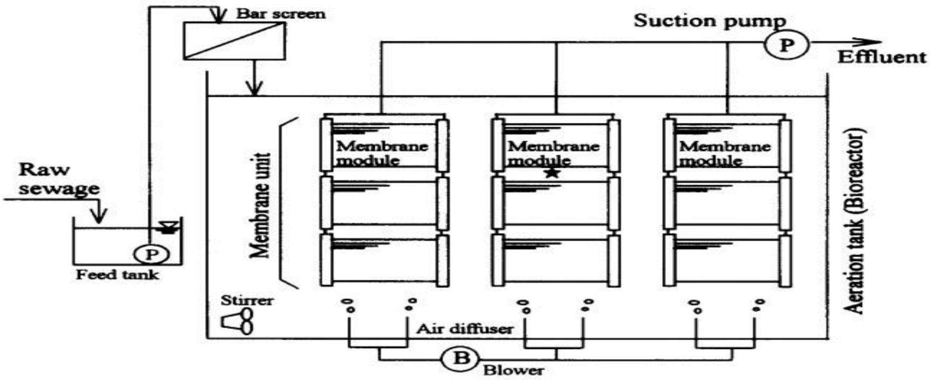

Fig. 7. *Bioreactor scheme with submersible membranes [12]*

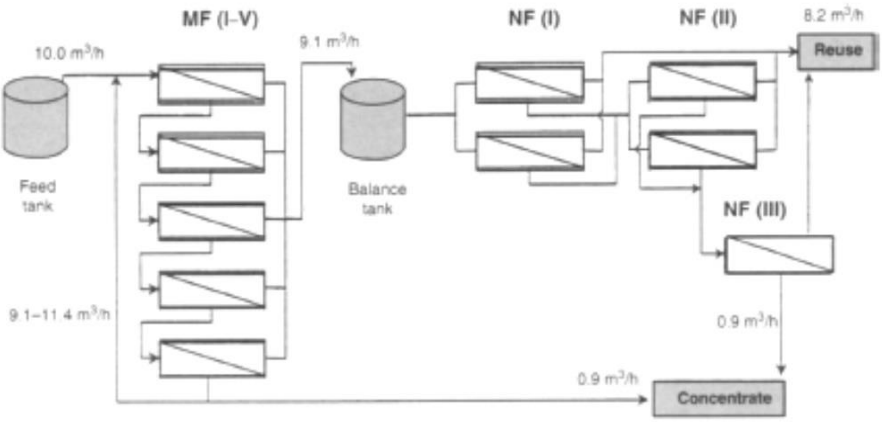

Fig. 8. Dual-treatment system for domestic wastewater treatment [14]

Hospital effluents are generally considered to have the same pollutant effects as urban waste water and are therefore co-treated at the same treatment center without paying particular attention to the potentially harmful nature of the substances they contain.

Knowing that they can also affect the aquatic environment.

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