Treating Pharmaceutical Wastewater is a challenge because of its complex nature.

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TREATING PHARMA WASTEWATER

Identifying optimal solutions for wastewater treatment in the pharmaceutical industry — Treating Pharmaceutical Wastewater is a challenge, because of its diverse characteristics and varies. But it's not necessary to make new developments. It might be a valid strategy finding a workaround based on existing solutions.

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Ever since concerns about the potential risks of pharmaceutical pollution were raised in the late 1990s, environmental authorities have addressed the issue and introduced policies that are continuously updated and strictly enforced. But the appropriate treatment of wastewater accrued during the operation of pharmaceutical manufacturing facilities still poses a challenge for the industry, because generic treatment methods are unable to remove trace amounts of pharmaceuticals which might end up in the effluent water.

Naturally, because of the constant exposure, aquatic life has a higher risk to be negatively affected: While some anti-inflammatory drugs were shown to damage the gills and lungs of fish, some hormones or compounds that mimic properties of hormones are capable of feminizing or masculinizing them and pose a threat to their population. Water scarcity in some areas resulted in the practice of wastewater reuse, exposing humans to trace amounts of pharmaceuticals as well.

The industry understands the negative impact of water contamination all too well and is committed to protect the environment and comply with the continuously updated standards. But generic methods, designed to address a wide range of potential waste, are not applicable to their specific needs. Pharmaceutical Wastewater (PWW) is often mixed with other types of waste and the type and amount of the manufactured drugs is different for each facility. As a result, PWW has diverse characteristics and varies e.g. in terms of BOD, specific drug residues and pH-value, requiring treatment methods that are specifically targeting certain types of waste.

Existing Solutions for Pharmaceutical Wastewater

Instead of developing entirely new approaches, it might be a valid strategy to find a workaround based on existing solutions—and save time and money as a result. This would include to explore already-operating plants and identify the best available technology for similar projects. Some of the conventional methods (which can be differentiated into physical, chemical, biological and thermal treatment) remove at least certain pharmaceuticals and might already suffice.

Activated Sludge Process is for example a common (biological treatment) method that leverages microorganisms to degrade organic compounds in the wastewater. But the ability to break down the pollutant varies. Drugs like sulfamethoxazole (antibiotic), ibuprofen and acetylsalicylic acid (a breakdown product of Aspirin) degrade within two to five days up to 98 %; antiepileptic like gabapentin degrade at least partially. Roxithromycin (antibiotic) on the other hand, needs five to ten days to degrade, while drugs like Carba-

PROCESS-Tip
- Exyte exhibits at **Lounges – Cleanroom Processes** in Vienna from 16 to 17 October 2019.

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mazepine (antiepileptic drug) and Diazepam (psychoactive drug) have shown no significant degradation even after 20 days. Therefore, alternative methods are required to destroy trace amounts of toxic drugs in the wastewater.

Another viable solution for PWW treatment is an advanced membrane process to remove or concentrate the drugs from the wastewater. Two widely used membrane technologies are Nano Filtration and Reverse Osmosis. Again, the effectiveness varies depending on the characteristics of the waste in question. With a pore size of 0.002 micrometres (2 nm), a typical Nano Filtration filter is able to remove most organic substances, almost all viruses, other organic molecules and a range of salts but lacks when it comes to rejecting pollutants with a lower molecular weight. Those can be addressed by using the pressure-driven membrane filtration called Reverse Osmosis (typical filter pore size of 0.1 nm). A membrane process has a lower footprint, is quick to build with standardized ready-to-use systems available and therefore easier to accommodate in existing facilities. However, both the equipment and its energy-intensive operation are costly and this treatment is not a destruction process but merely separates and concentrates the pollutant. Some kind of destruction process (thermal/chemical/aerobic oxidation) is required to remove it afterwards and the concentrate needs to be hauled out or evaporated for a zero-liquid discharge.

An Advanced Oxidation Process (AOP) is a method that either destructs the pollutant or converts non-biodegradable into biodegradable. AOP is an answer to most refractory drugs that escape aerobic oxidation, chemical oxidation or membrane process.

Based on the characteristics of the drug residue in the wastewater, multiple treatment options are available. Each of them has its own advantages and disadvantages:

Source: Exyte

Pharmaceutical Wastewater is often contaminated with manufactured drugs.

They address only certain types of waste and might have to be combined to effectively prevent water contamination. Or they are expensive to implement and operate —even though parts of the investment might be recovered by recycling the water for non-critical processes. Especially when upgrading existing facilities, space constraints have to be taken into account as well.

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From Identification to Testing to Implementation

Since there is no one-stop solution applicable to every type of pharmaceutical manufacturing facility, the "Best Available Technology" has to be identified to ensure the protection of the environment and a certain return on investment. From both a technical and a business perspective plenty of variables have to be taken into account before implementing a commercial system, requiring a phased execution plan and tests in a real-world environment. From Exyte's perspective, the development path for each facility has to include an evaluation of both, the existing systems and the characteristics of the PWW, and a pilot test system to estimate cost and performance, identify potential operational problems and evaluate the requirements of a full-scale, automated solution.

Exyte is able to provide all services required for such projects: analysing the environmental situation and conducting a process study, developing a concept and later a detailed design, undertaking the necessary constructions and installations and even commissioning and certifying the complete system.

Global Network of Engineers And Technologists

Leveraging its global network of engineers and technologists and well-connected with equipment manufacturers and technology providers, Exyte can identify, test and implement an optimal solution for each project. Regulations often enough don't leave much of a choice anyway, but the protection of the environment should be in all our best interest. Excyte feels well positioned to support client's efforts with the complete scope of services and global engineering expertise.

Filter Cells

FILTER CELLS PROVIDE OPTIMISED FLOW

Source: Eaton

Eaton has developed a new generation of stacked disc cartridges to provide a more efficient and cost-effective stacked disc cartridge filtration. The Becodisc R+ with expanded filter surface area can be used for coarse, clarifying and fine filtration as well as for microbial reduction and microbial removal filtration of wine and beer. According to the company, the individual filter cells are produced using extra-efficient depth filter sheets made of high-purity cellulose. High pressure is applied to join the cells with an intermediate layer of multi-layer polyester fabric. The honeycombed polyester fabric fills the space between the cells, forming a cushion. This allows for optimum inflow into each cell and optimum use of the entire filter surface, states the firm.

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