Pharmafilter

BUSINESS ALL-STARS
PHARMAFILTER GROUP HOLDINGS
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ACCREDITED

On-Site Waste and Wastewater Treatment for Healthcare

MERGING **HEALTH** TECH - **CLEAN** TECH - **GREEN** TECH

Introduction

The Pharmafilter system is an on-site solution to hospital generated wastes and wastewater. The system automates the transport and treatment of wastes arising on ward level (or other nominated areas of the hospital) by introducing Tonto Shredders to process solid waste (ie risk waste, sharps, lab/pharmacy waste, household refuse, food waste, disposable bed pans urinals and PPE), by using the existing or dedicated sewer network as a transport conduit. The reduction in manual transport of these materials through the hospital and the use of single use bed pans and urinals results in several benefits to the hospital - not least in relation to patient and staff safety. As the sewer network has been optimised in this manner, intervention is required to separate the solid wastes from the wastewater, and decontaminate both solid and liquid wastes. The resulting output is dry decontaminated inorganic material (plastics, metals etc) for recycling or repurposing, and purified clean water suitable for reuse as grey water or discharge to public sewer.

In implementing the Pharmafilter system, the partner hospital has dramatically diminished its environmental footprint in terms of reduced waste transport (local and international) and carbon emissions, removal of all chemical, pharmaceutical and biological micro-pollutants in hospital wastewater (including AMR - antimicrobial resistant pathogens) and their subsequent dissemination though public infrastructure into the broader environment.

Globally, healthcare is significantly challenged by rising antibiotic resistance, hospital-acquired infection, staff shortages, capital and operational funding pressures. In deploying the Pharmafilter system, hospitals are removing the input of pharmaceuticals including antibiotics, to the environment via hospital wastewater - a critical point in antibiotic stewardship. In addition, essential support services are automated, benefitting staffing, operations, efficiencies, economics, hygiene, patient and staff safety.

From waste management to water use to the near-zero carbon targets, Hospitals are operating under increasing environmental regulation at a time when demand for expert care is growing.

Hospitals are required and expected to treat and care for patients while also contributing to a healthy society and sustainable environment. The on-site Pharmafilter approach of combined treatment of hospital waste and wastewater has proven environmental benefits, while also improving patient care.

The healthcare sector possesses a unique healing purpose. Yet, hospitals are key point sources for specialised pharmaceutical and microbiological residues entering the environment. It is a substantial source of contamination that can endanger ecosystems and the environment and accelerate the development of antimicrobial resistance (AMR) – a severe public health threat, previously predicted to kill over 10m people pa by 2050, however the World Health Organisation now believes this grim reality will be realised sooner.

Up to 90% of orally administered pharmaceuticals are excreted into wastewater as active substances in the faeces and urine of patients. This enables pharmaceuticals and their metabolites to be released into the aquatic ecosystem through hospital effluents. Due to technical and economic constraints, it is not possible to remove these contaminants at a receiving wastewater treatment plant because of the specialist removal techniques required.

Pharmaceuticals are, by design, intended to interact with living organisms, even low environmental concentrations are a concern. While conventional medicines are frequently consumed in the community, more specialised pharmaceutical products, e.g., cytostatic drugs, (restricted) antibiotics, and X-ray contrast agents, are principally administered in hospitals and clinics.

In addition, the generation of waste categories within a healthcare setting and the management and disposal of same, continues to generate unprecedented challenges in terms of increased volume and increasing costs for all concerned. Moreover, the global waste supply chain is undergoing transformative realignment and adjustment. Given ongoing environmental legislative reform, whereby healthcare risk waste is becoming restricted to the country or jurisdiction wherein it arises and placing limits for official shipping and movement for disposal around the globe, the Pharmafilter system is at the nucleus of resolving these challenges.

The Pharmafilter on-site system and operation method provides a combined approach to both efficiently and effectively manage healthcare-generated wastes and wastewaters at the source.

This aligns with established EU policy as it relates to Proximity and Self-Sufficiency Principles of the Waste Framework Directive. Moreover, it future proofs client hospitals in relation to the evolution of thhe Water Framework Directive, which in 2013, due to concerns around pharmaceutical inputs contributed to the EU amending the Water Framework Directive where...

"Diclofenac (CAS 15307-79-6), 17-beta-estradiol (E2) (CAS 50-28-2) and 17-alpha-ethinylestradiol (EE2) (CAS 57-63-6) shall be included in the first watch list, in order to gather monitoring data for the purpose of facilitating the determination of appropriate measures to address the risk posed by those substances."

And,

"Pursuant to Article 16(9) of Directive 2000/60/EC, and where appropriate on the basis of the outcome of its 2013 study on the risks posed by medicinal products in the environment and of other relevant studies and reports, the Commission shall, as far as possible within two years from 13 September 2013 develop a strategic approach to pollution of water bypharmaceutical substances. That strategic approach shall, where appropriate, include proposals enabling, to the extent necessary, the environmental impacts of medicines to be taken into account more effectively in the procedure for placing medicinal products on the market. In the framework of that strategic approach, the Commission shall, where appropriate, by 14 September 2017 propose measures to be taken at Union and/or Member State level, as appropriate, to address the possible environ- mental impacts of pharmaceutical substances, particularly those referred to in Article 8b(1), with a view to reducing discharges, emissions and losses of such substances into the aquatic environment, taking into account public health needs and the cost-effectiveness of the measures proposed."

(See article 8b of the 2013 Amendment to the Water Framework Directive)

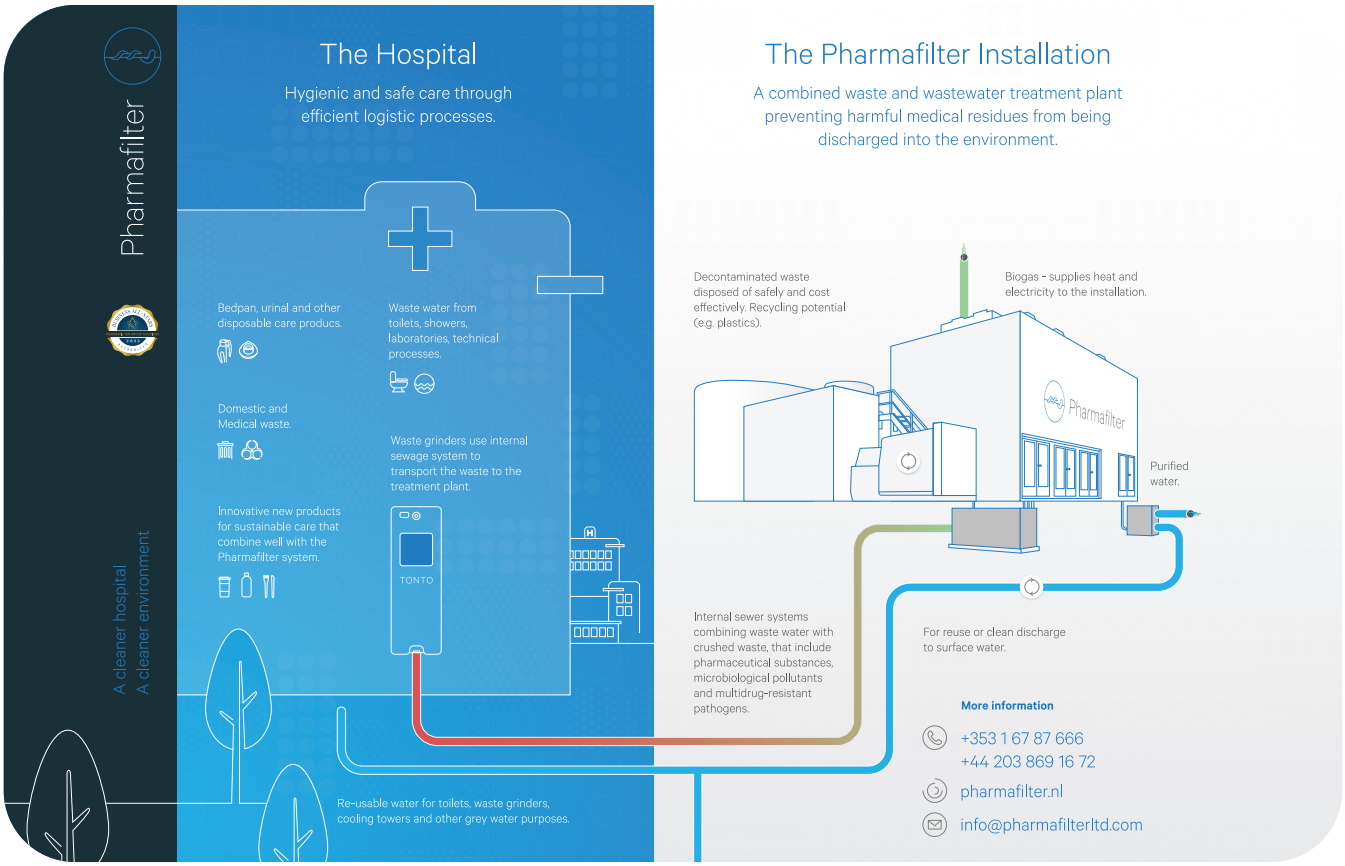
This is the first time pharmaceutical substances have been included on a WFD watch list and the amendment clearly sets out the considerations under which future policy will be developed..

The on-site Pharmafilter plant completely eliminates hospital-specific contamination (pharmaceuticals, contrast media, cytotoxins, hormone disrupters, AMR pathogens, Covid 19, etc.) and other hazardous substances encountered in healthcare (Lab liquids/ wastes, cleaning agents, etc.) in the wastewater treatment phase. Removal of these substances results in a pivotal decrease in the environmental footprint of the hospital or healthcare facility.

The platform improves service delivery and achieves better outcomes for the hospital, its patients, staff, and the environment.

The Pharmafilter System is designed to:

1. Substantially reduce waste and eliminate associated waste staffing and management costs.
2. Decontaminate and recycle water used by the hospital and reduce costs, up to 70% recycling possible.
3. Process and decontaminate all hospital-originating hazardous substances/materials, and prevention of these entering the environment.
4. Automate the transport and decontamination of hospital generated waste material, reducing the opportunity for cross-contamination moments and needle stick injuries.
5. Remove buffering, storing, and reduce internal waste movement throughout the hospital.
6. Enable cleaner, safer, more efficient working practices with the potential to render many parts of existing source segregation of waste management procedures obsolete.
7. Create a platform to develop new approaches for reducing the risk of hospital-acquired infections, notably C. Diff, and improved efficiencies around Norovirus breakout. (HAI occurs at an incidence level of c 6% in hospitals.)
8. Prevent the discharge of anti-microbials, pharmaceuticals, and other healthcare-specific micro-pollutants, pathogens contained in hospital wastewater to public infrastructure (e.g., including AMR and Covid 19).
9. Recovers energy from the organic fraction of the wastes processed on-site (Biogas).
10. The remaining non-organic fraction is recovered, recycled or repurposed resulting in 100% diversion of all waste from landfill.
11. Develop data and critical information on waste, wastewater management, both influent and effluent.
12. Future proof for legislation, increases in associated costs, including improved clinical cost-benefit opportunities.
13. Better and improved use of resources and increased safety in related waste handling.
14. Reduction of truck movements servicing the hospital waste.
15. When fully optimised, hospitals are supported and empowered to make real progress towards meeting carbon reduction targets and progressively improving their carbon and environmental footprint.



Hospital Wastewater

The wastewater of hospitals comprises a high concentration of pharmaceuticals, such as antibiotics, painkillers, cytotoxic substances, heart medicines, and contrast media. These substances are released through urine and faeces to the wastewater system and, despite excellent biological treatment in wastewater treatment plants, are ultimately discharged into surface water. It is now understood that these toxic and mutagenic compounds are responsible for disrupting water life and causing disease and malformation in water organisms through their hormone-disrupting activity, among others. At this moment, these disrupting substances are focusing environmental policy. Placing this issue high on the agenda, the World Health Organization (WHO) published a list of global priority pathogens (GPP) – identifying species of bacteria with critical, high, and medium antibiotic resistance (AR).

Antimicrobial resistance (AMR) threatens the effective prevention and treatment of an ever- increasing variety of infections caused by bacteria, parasites, viruses, and fungi.

The EPA in Ireland in 2019, following a six-year study, published a report on antibiotic resistance as being a significant public health problem. In Ireland, the UK and most of Europe, hospital effluent is released into the urban wastewater system without any specific measurement of antibiotic levels of antibiotic-resistant bacteria and without any pre-treatment to mitigate the release of these pathogens into the aquatic environment (see “Hospital effluent: A reservoir for carbapenemase-producing Enterobacterales”)

Hospitals are seen as a “hot-spot” of pharmaceutical emissions because there is a high load of pharmaceuticals used and emitted through hospital wastewater into local municipal sewerage.

Municipal wastewater treatment plants by design cannot deal effectively or economically with these challenging healthcare wastewaters. Nevertheless, they influence a condition which generates an opposite result - as they provide a perfect environment and breeding ground for the multiplication of Antimicrobial-Resistant Bacteria, which finds its way into our environment.

Resulting from the Pharmafilter Treatment process, Wastewater is purified, and all drugs, micropollutants, and viruses are removed, including Antimicrobial Resistance Bacteria and Covid. The clean water is recycled for reuse -flushing toilets, waste shredders, etc. The waste is shredded and transported to the on- site plant through the existing wastewater pipework, decontaminated, and all treated waste fractions are utilised, recycled, repurposed, and organics converted to energy. The installation and deployment of the Tonto advanced intelligent shredders eliminate the need to segregate waste, including all the various collection bins, bags clogging wards, corridors, clinical spaces, and waste transport containers. It also reduces cross-infection, mis-sorting, damage to the buildings, and congestion.

Hospital Waste

Since 2008 Pharmafilter has operated in the Netherlands and is a complete, integrated waste and wastewater management solution, which takes waste at the source (wards, consulting, dirty utilities, sluice rooms, and throughout a facility) and accepts and treats pharmaceuticals, swill, sewage, general refuse, clinical, and healthcare risk waste.

The Pharmafilter upstream or on-site waste and wastewater treatment system significantly benefits the host hospital, the local community/ municipality, and the environment. The treatment unit is designed to reduce cross contamination moments and meet the complete decontamination requirements of the specific wastes generated in hospitals. This purpose-built system has none of the gaps or potential failures of more general designs or methods. This allows the hospital to eliminate the hazardous element of all waste exported off-site. Therefore, the hazardous material is neither transported through the local community nor shipped out of the country once treated by the Pharmafilter system, as is currently the case with some healthcare risk wastes. This particular supply chain (like others) is experiencing structural and legislative changes that create local and international bottlenecks.

Given that most hospitals are publicly funded and are required to meet government commitments regarding carbon emissions, opportunities to reduce the carbon footprint of operations are actively being explored. As the system incorporates an anaerobic digestion element, any organic fraction included in the waste stream is digested with the resulting biogas converted to energy to power the Pharmafilter plant. This digestion process, coupled with the shredding of material, dramatically affects the physical volume of the remaining residue. As a result, truck movements servicing waste are reduced by approximately 70%. (An exact number is difficult to project as a hospital may elect to maintain specific recycling streams or have a unique initial waste profile.) The effect on reducing the need for national and international transport contributes to the hospital's carbon emission targets.

In this context, the Tontos too have a decisive impact on carbon emissions. Conventional bedpan washers are installed to sterilise reusable bedpans. However, there is considerable dissatisfaction with this practice from infection control professionals employing reusable bedpans, as it is considered unreliable in the context of a high-risk environment like a hospital ward. A combination of hot water and chemical decontamination is used in bedpan washers and sluices. The Tonto shredder is a cold-water process only and has an inbuilt disinfectant capability for the waste compartment. It can take this approach, as decontamination for reuse is not required.

The system is a thoroughly integrated waste disposal and waste & wastewater decontamination system that at every stage delivers significant improvements in the handling, removal and treatment of waste streams arising from hospitals. It is a 'clean-technology' process for dealing with complex waste, sewage and wastewater.

Funding As a Service: Design-Build, Finance, Permit/License, Maintain, Operate and Own

Pharmafilter Group Holdings Ireland Ltd is the responsible entity for the business in Ireland and the UK. It provides the system on a fully financed "As a Service" basis, allowing the client to retain their capital budget for other uses. The "As a Service" basis to the Hospital or Health Service Authority is founded on an in-depth business case identifying areas of savings capable of being generated by the Pharmafilter system at each site. It delivers a lifetime operational framework for the client regarding finance, operations, project management, delivery, security of supply, insurances, environmental and statutory regulation, increased volume, and future emission limits. The engagement incorporates a complete turnkey solution including design, build, permit / license, maintain, own and operate. This approach passes the long term Operational responsibilities unto Pharmafilter and significantly relieves the hospital's capital and budget pressures and operational complexities. In circumstances where the hospital or contracting authority wish to provide capital funding, the structure is flexible enough to accommodate individual financing arrangements.

Procurement Public and Private

The Company and the solution have qualified for procurement in four separate contracting authorities in Ireland, Netherlands, Germany and Switzerland. All procedures were robust and comprehensive and provided the CA with the required surety around the contracting counterparty - Pharmafilter, the system, supply structure, operations track record, and the capability to deliver and maintain the mandated services.

EPA Licensing and Building Permit

Pharmafilter is presently deployed across the fourth most extensive hospital campus in Europe, i.e. the Erasmus University Teaching Hospital Rotterdam. The EPA has granted the Pharmafilter solution its first Industrial Emissions license in Ireland. In the Netherlands, we achieve a comparable licensing and permitting process with the EPA and the required building permits with the local authorities.

The EPA has indicated that it has benefitted substantially from our application in terms of its understanding and knowledge base. Given that the systems processes are standard, future applications will also benefit from that experience.

Feasibility & Project approach

In conjunction with a potential client Hospital's staff, Pharmafilter investigates the suitability of its W&WW Treatment system as a comprehensive solution for waste and wastewater generated by the hospital. This assessment includes the ability to expand the system's capacity as the demands of the facility grow into the future, outside the initial stated capacity of the system.

Over multiple site visits from both the civil and process engineering teams, measurements, massing and structural surveys, and desktop reviews of historical and current information are undertaken to confirm site suitability. Where site circumstances require solutions that deviate from the standard modular configuration (NB. but not process), more detailed preliminary engineering work is required. The system has been deployed in a non- standard in Erasmus MC in Rotterdam.

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