

EFFLUENT DISINFECTION

Technical showcase



MARSH:UV
DISINFECTION UNIT



Effluent disinfection for off-mains drainage

Marsh Industries managing director, Steve Boyer, explores the principles of UV disinfection for the removal of harmful micro-organisms, such as coronaviruses, from sewage treatment plant effluent.

Modern sewage treatment plants are efficient systems used to process waste water from domestic or commercial premises to a standard that allows outflowing effluent to be discharged into natural bodies of water, such as drainage fields, streams, rivers or lakes.

The sewage treatment plant removes toxic constituents, such as suspended solids, nitrogen and ammonia, etc, however microscopic bacteria can remain undetected within the outflowing effluent. This bacteria is typically harmless, but the risk remains that some hazardous bacteria, such as coronaviruses, could survive and prosper in the natural environment.

As Covid-19 marches across the globe, public health, personal hygiene and sanitation is at the forefront of everyone's mind. Biologists, public health experts and researchers are exploring all possible routes of virus transmission, including the possibility of contamination from water and sewage.

Covid-19

Although it is not yet proven that Covid-19 can survive or spread through contact with water and sewage, environmental biologists at the University of Stirling have warned that the potential spread of Covid-19 via sewage "must not be neglected" in the battle to protect human health¹.

Richard Quilliam, Professor of Biological and Environmental Sciences at the University of Stirling, who is currently leading a £1.85m study into the transport of bacteria and viruses in marine environments, said "We know that Covid-19 is spread through droplets from coughs and sneezes, or via objects or materials that carry infection. However, it has recently been confirmed that the virus can also be found in human faeces up to 33 days after the patient has tested negative for symptoms of Covid-19."

"It is not yet known whether the virus can be transmitted via the faecal-oral route, however, we know that viral shedding from the digestive system can last longer than shedding from the respiratory tract. Therefore, this could be an important, but as yet unquantified, pathway for increased exposure."

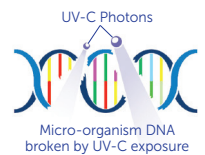
The authors of the peer-reviewed paper presented the example of the severe acute respiratory syndrome (SARS)

In principle - The effects of UV light on bacteria

Bacteria, which causes some of our most common illnesses, are single cell organisms.

When looking inside a bacterium, the simplicity of the cell is evident; the cell contains DNA, ribosome and other basic proteins – this simplicity increases its susceptibility to UV light.

UV-induced DNA damage can affect how proteins and enzymes are produced. UV can also increase reactive oxygen species production, which can react with the cell wall. The cell wall and other components of the cell can become severely damaged, thus halting cell growth.



outbreak in 2002-2003 when SARS, closely linked to the Covid-19 virus strain, was detected in sewage discharged by two hospitals in China.

Professor Quilliam highlights that, as most Covid-19 patients are asymptomatic or experience just mild symptoms and remain at home (not in hospital), there is significant risk of "widespread" distribution through sewers.

Effluent disinfection

For over a century scientists have known about the ability of ultraviolet light (UV) to disinfect and, for many years, UV-C² lamps have been used for disinfection in medical settings, food production and a number of other places.

Effluent disinfection using UV light is the decontamination of outflowing water from sewage treatment plants, sewer pipes or industrial outfall into natural bodies of water.

Without UV disinfection, effluent can retain a mass of hazardous pathogens that could infect the natural water, causing potentially serious environmental health issues.

UV light deactivates pathogens so that they cannot survive in clean water, meaning they cannot replicate and infect future waterways.

UV light is one of the safest disinfectants available due to the lack of chemicals used and produced by the device.

The most common method of effluent disinfection used in off-mains sewage treatment plants is to install and connect a separate UV disinfection unit to the outlet of the sewage treatment plant.

The UV disinfection unit contains the necessary UV light system to match the volume of outflow from the sewage treatment plant.

It should be noted that when introducing a UV disinfection unit to a sewage treatment plant, it is necessary to ensure that the flow of water does not exceed the depth the UV light can travel. UV light can only pass through a certain amount of water before it becomes ineffective. Making sure that the water flow is uniform with the UV light means that the effluent will receive the best disinfection possible.

The solution - Marsh:UV Disinfection Unit

Marsh Industries has developed an innovative UV disinfection system which removes 99% faecal coliform bacteria levels from sewage treatment plant effluent.

The Marsh:UV Disinfection Unit can be supplied as an integral part within the Marsh Ultra:Polylok range of sewage treatment plants (50-500+PE) or as a stand-alone unit which can be installed at the outlet end of any existing sewage treatment plant. See figure 1.

The UV light(s) are mounted in a sub-assembly which can be easily removed for periodic servicing and bulb replacement. In stand-alone units, the light assembly is mounted in a primary chamber by an anodized aluminium frame. The frame seals against the inner surface of the primary chamber to prevent flow bypass.

When the disinfection unit is filled with waste water, the ultraviolet light source operates continuously with a lamp surface temperature range of 105-120°F providing optimum UV light output and long lamp lifetime (Power supply is via 230v Single Phase with consumption of a single UV lamp being 45 watts).

In addition to the UV disinfection assembly, microfibre tertiary filters are attached at the inlet pipe to reduce any remaining suspended solids, residual BOD and ammonia levels.

UV treatment performance

A single UV maximum flow through the unit is rated at 16m³ per day or a peak flow rate .056 litres per second under the following conditions:

- UV dosage is greater than 5mJ/cm²
- Suspended Solids – less than 30 mg/litre
- BOD (5 days) – less than 30 mg/litre
- If the effluent is cleaner than the above figures the level of treatment is greater

From the above conditions, the faecal coliform reduction by the Marsh:UV Disinfection Unit exceeds 99.9% or 3-logs, at the end of UV lamp life, which is two years of continuous operation.

Figure 2 below provides an indication of the UV dosage requirements in order to provide a 90-99% reduction in different strains of coronavirus.

Figure 1 - The Marsh:UV Disinfection Unit

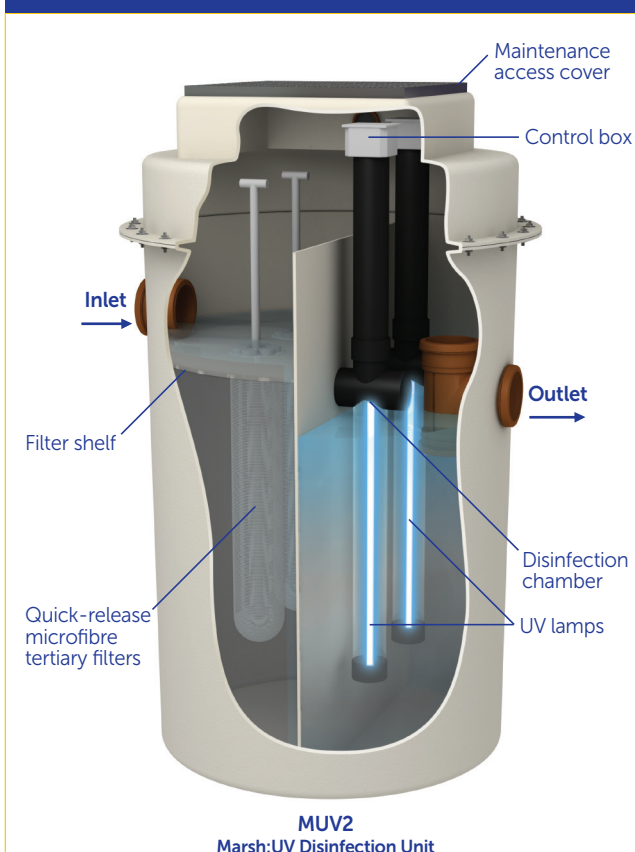


Figure 2 - UV dosage requirements to provide a 90-99% reduction in different strains of coronavirus (where historical data exists)

Organism	90% (1 log reduction) mJ/cm ²	99%* (2 log reduction) mJ/cm ²	Source
Coronavirus	0.7	2.1	Walker 2007
Berne virus (Coronaviridae)	0.7	2.1	Weiss 1986
Murine Coronavirus (MHV)	1.5	4.5	Hirano 1978
Canine Coronavirus (CCV)	2.9	8.7	Saknimit 1988
Murine Coronavirus (MHV)	2.9	8.7	Saknimit 1988
SARS Coronavirus CoV-P9	4.0	12.0	Duan 2003
Murine Coronavirus (MHV)	10.3	30.9	Liu 2003
SARS Coronavirus (Hanoi)	13.4	40.2	Kariwa 2004
SARS Coronavirus (Urbani)	24.1	72.3	Walker 2007
Average	6.7	20.1	

Notes

¹ <https://www.stir.ac.uk/news/2020/05/sewage-poses-potential-covid-19-transmission-risk-experts-warn>

² UV-C refers to ultraviolet light with wavelengths between 200–280 nanometers (nm). Light in the UV-C wavelength can be used for disinfecting water, sterilizing surfaces, destroying harmful micro-organisms in food products and in air.

For further technical specifications on the Marsh range of UV Disinfection Units, please contact our Technical Team on sales@marshindustries.co.uk | 01933 654582

Marsh:UV Disinfection Unit benefits

- Removes 99% faecal coliform bacteria levels from sewage treatment plant effluent
- Optimum UV light distribution assembly for maximum disinfection (UV dosage requirements to provide a 90-99% reduction in different strains of coronavirus)
- Can be supplied as an integral part within the Marsh Ultra:Polylok range of sewage treatment plants (50-500+PE) or as a stand-alone unit
- Unique microfibre tertiary filters further reduce remaining suspended solids, residual biological oxygen demands and ammonia levels
- Optimised for minimal running costs
- Heavy duty shell as standard to enable installation in all ground conditions
- Integral eye bolts for improved on-site handling
- 'Keying-in flange' assists anchoring into granular or concrete surround
- Pedestrian cover included as standard

Structural integrity testing

Structural integrity tests, performed in accordance with EN ISO 179-1/1eA: 2010-11, were undertaken to evaluate the strength of Marsh Industries' GRP materials against similar GRP materials used by other manufacturers.

Three separate material samples were submitted for impact testing; Marsh GRP material (virgin unfilled resin), a GRP material containing calcium fillers and a GRP material containing sand filler.

The tests involved 12 samples of each material at a size of 80x10x5mm. The nominal pendulum energy was 15J at an impact velocity of 3.8m/s.

Results proved Marsh GRP material to be 40% stronger than the other materials tested.

Fire resistant testing

Fire resistance testing was performed to assess ignitability of products subjected to direct impingement of flame. Marsh Industries' GRP material passed all practical testing to achieve EN ISO 11925-2:2010 standard.



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