

Clean Water Wave

The Tertiary Treatment of Municipal Wastewater by The CAFE filter

Why we love (removing) Suspended Solids!



Suspended solids in municipal wastewater – it's the little things that get us?

Scottish based social enterprise, Clean Water Wave (CWW), has had one of their CAFE Water Filters, featuring their patented backwashing technology, running for over a year now at a specialist testing site near Edinburgh. Along with a world-renowned research institute and specialist water treatment advisors to keep the CWW team on the right track to verify the CAFE performance, the emerging results make for thought providing reading in the light of this current pandemic.

What's really struck the CWW team is that **only an estimated 10%** of all municipal wastewater systems in Europe, and next to none in the developing world, are fitted with tertiary treatment to remove suspended solid particles. Yet, all wastewater treatment facilities discharge particles back into the environment.



This discharge might go directly into the sea, or a river. Sometimes discharge can be released up-stream of an abstraction point where water is taken out to be treated and used for drinking. Examples include, the Thames, England and the Rhine, which runs through several European countries.

Why are we bothered

It is increasingly becoming our view that irrespective of where wastewater is discharged, the suspended solids content should be as low as possible if we care about minimising the negative impact and risk to human health and harm to the wider environment.... And, if you know, you can jump to the results bit further down the page, but if you don't know why this stuff matters, here's why... suspended solids in municipal wastewater can contain the following:

- Both alive and old dead bits of bacterial cells (biomass)
- bacteria and phage's - may be resistant to antibiotics and can pass it on to people further down the line
- micro-plastics (research now shows we consume a credit card a week or 2000 tiny bits)
- toxic carcinogenic, mutagenic and endocrine disrupting chemicals attracted to and adsorbed onto the surface of micro-plastics and all ready for eating by aquatic life
- pharmaceuticals, carried by bacteria and microplastic plastic
- human pathogens, viri, fungi, and parasites
- plastic incubates pathogenic bacteria and carries viri

What bothers us is that there are literally billions of bacteria and plastic micro-particles are discharged from municipal wastewater treatment plants every day. The vast majority of bacteria are harmless, but some can be quite nasty or pathogenic if they get back into the drinking water systems or into rivers or lakes used for recreational purposes.

Astonishingly, we are now learning that microplastics can carry and selectively incubate certain species of bacteria for example, *Vibrio cholera* and *Mycobacterium tuberculosis*. We also now know that they pick up and carry viri such as the coronavirus and hepatitis, and that the plastic helps the viri to survive for many days or weeks. Water treatment methods remove 90% of microplastics, but there are no specific standards for the removal of micro-plastics from drinking water or wastewater in Europe.

Every year more and more chemicals are released onto the market and no one has any idea what they do to humans, animals and other organisms. Many chemicals and pharmaceuticals are made up of very, very 'bio-active' molecules - designed not to break down in the environment and can stick around 'forever'. In theory, the chemicals that are lipid soluble hydrophobic (fat loving/water hating) can become concentrated by many thousands or even millions of times on the surface of bacteria and/or on plastic microparticles.

Given what we now know, and that "maximum permissible" concentrations published by agencies around the World, are based on analysis of what is found in solution, when in reality it is the suspended solids have been hiding their toxic secret. Meanwhile, 90% of water treatment plants in Europe are discharging particles which will have toxic hydrophobic chemicals/pharma concentrated on their surfaces - safe concentration recommendations need urgent review, and every waste water treatment plant should have tertiary treatment of some shape or form - all we hear is that water companies can't afford to put on tertiary treatment - at Clean Water Wave, our view is, that we can't afford to keep ignoring yet another obvious risk to human, animal and environmental health.

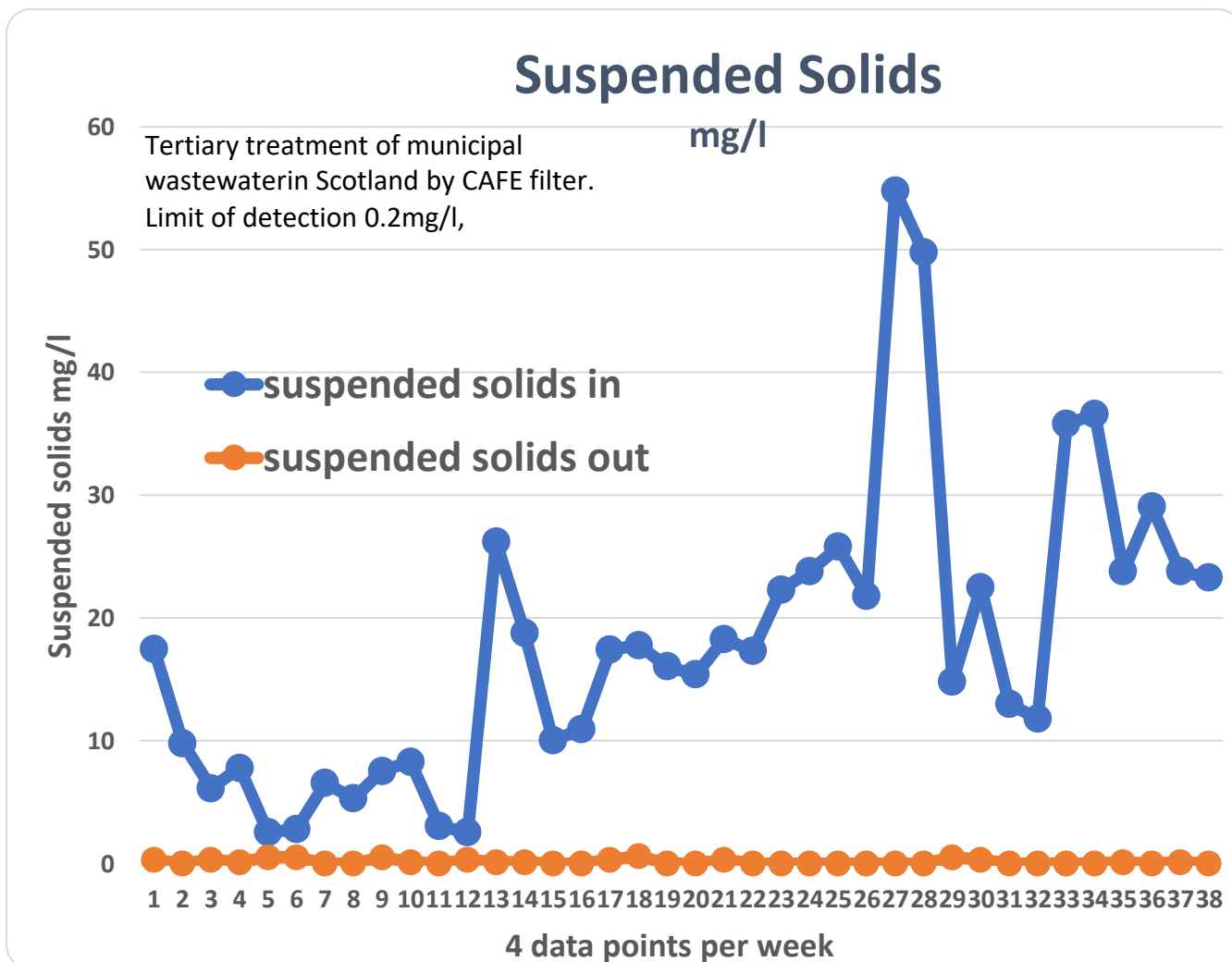
Results

How low can we go?

Our demonstration CAFE filter has been in continuous operation on a specialist test site for municipal wastewater treatment plant in Scotland for over 1 year. It has run continuously with virtually no attention, maintenance or consumables. CAFE's automated self-backwashing filter and the operational know-how is now patented. This low energy technology, is designed to provide high quality product water, running off just one pump with a simple control panel, (no pump/energy or control system is required if the water supply for treatment has a 4.5 metres pressure head). We designed CAFE to have no moving parts or valves, and after one year of testing, we now know the CAFE filter is very reliable, robust and it stacks up as a very sustainable offering for a sector that uses many hundreds of thousands of tonnes of

carbon intensive chemicals to treat water every year. The CAFE has emerged as a reliable, self-running, autonomous system, ideal for applications in rural and peri urban environments, for wastewater or drinking water.

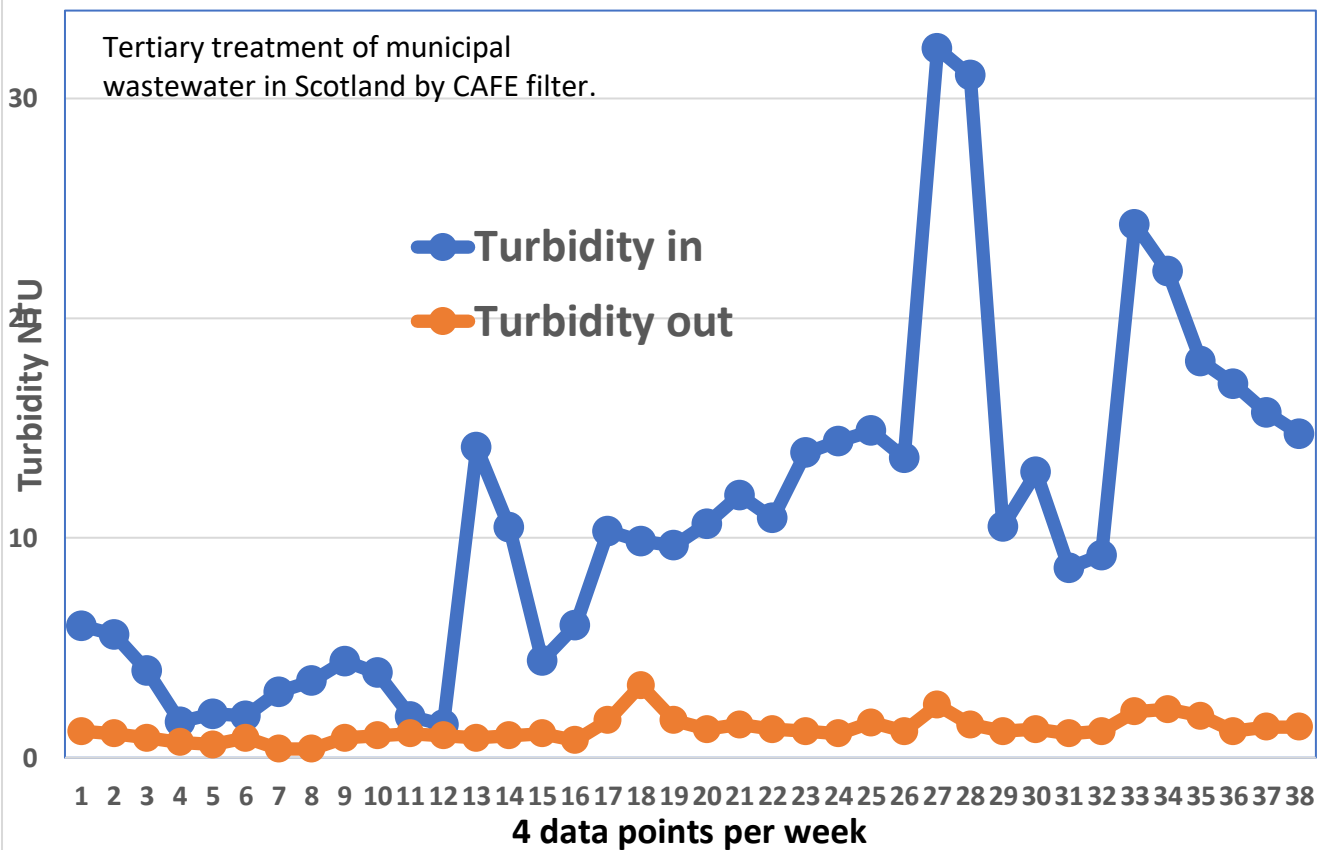
The following two graphs give a first look at the results from water samples taken in January 2020: independently collected from our CAFE filter and analysed by a World-renowned Scottish research institute.



The suspended solids results were nearly all below detection level of 0.2 mg/l in the product water, with an average removal rate better than 99%. Turbidity is also an indirect measure of solids in the water, and the CAFE filter gave an average in excess of 85% reduction of turbidity.



Turbidity NTU



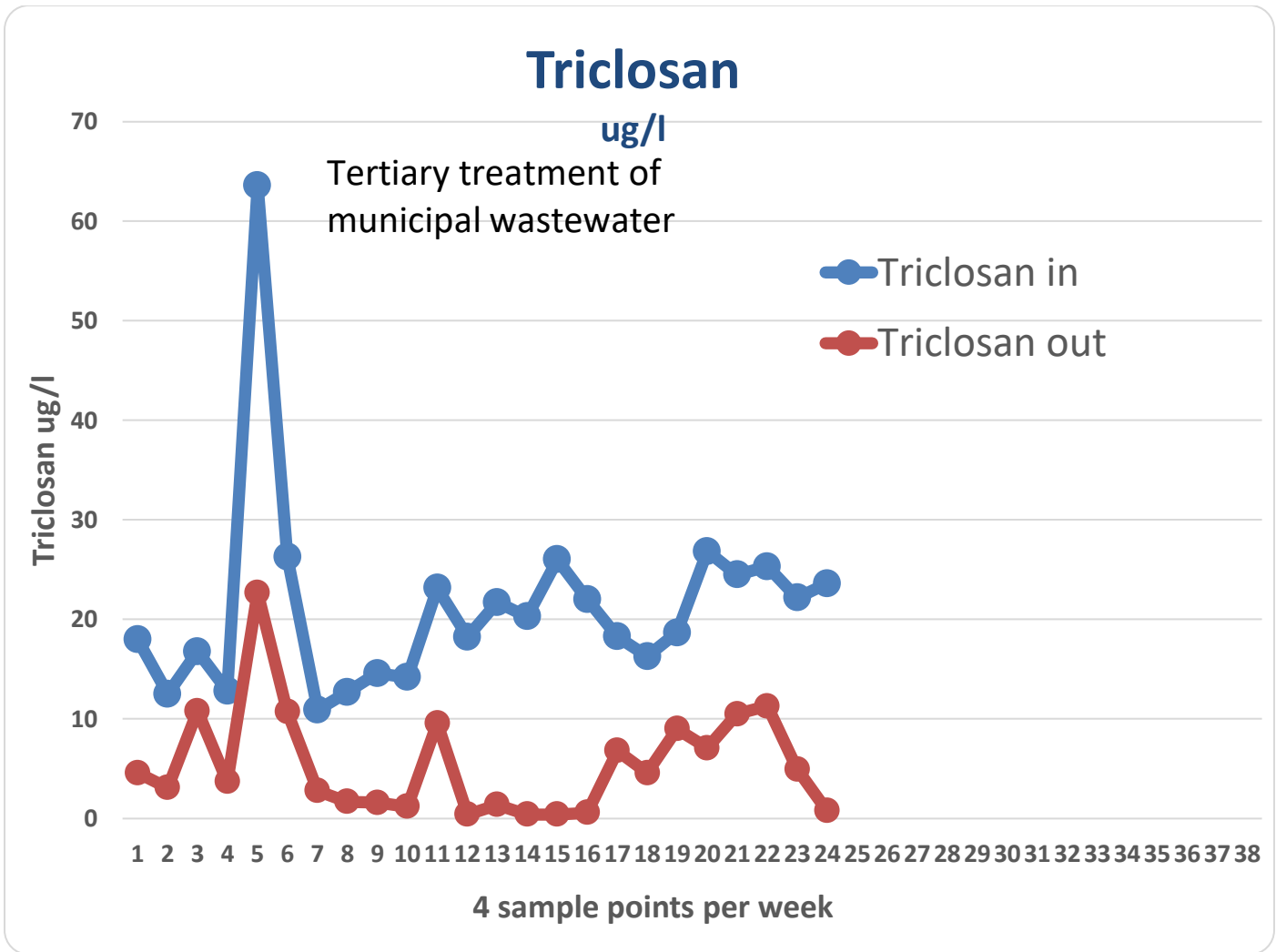
Opposites attract?

The CAFE filter uses AFM media (made by Scottish Company, Dryden Aqua Ltd) which is the World's best filter media and a direct replacement for sand. AFM not only mechanically removes tiny particles from water, but because each grain has been either positively or

negatively charged, it means that it attracts oppositely charged particles out of the water and onto the media (an adsorption reaction).

CAFE not only deals with particles, but also is making short work of the hydrophobic pharmaceuticals, herbicides, pesticides, hormones, endocrine disrupters and some of the toxic 'forever' chemicals that don't break down in the environment, are also being removed.

One example is the anti-bacterial chemical called Triclosan that is found in some toothpastes, hand sanitisers and many cleaning products. Triclosan is toxic to the environment, and there are also some human toxicity concerns surrounding the product. The results from test show CAFE removes more than 70% of the toxic chemical.



Continuous Product Development

Some sub-micron particles as well as hydrophilic (water soluble) chemicals will pass through the CAFE filter. The CWW team strongly believe that it is important to remove as many toxic chemicals from wastewater effluent as possible, so we are continuing to innovate and develop our CAFE technology because discharging toxins into the environment will ultimately impact on human health and the receiving environment. It's well published now that over 90% of all cancers are environmentally triggered and it seems a no brainer to halt the discharge of any biologically active toxic chemicals (especially toxic-for-ever chemicals such as PCBs and PFOS). It has to be obvious now that it really is the little things that can come back to bite us, and it

must make economic sense to not only remove these chemicals from the supply chain, but to innovate and invest in green chemistry for all the right reasons!

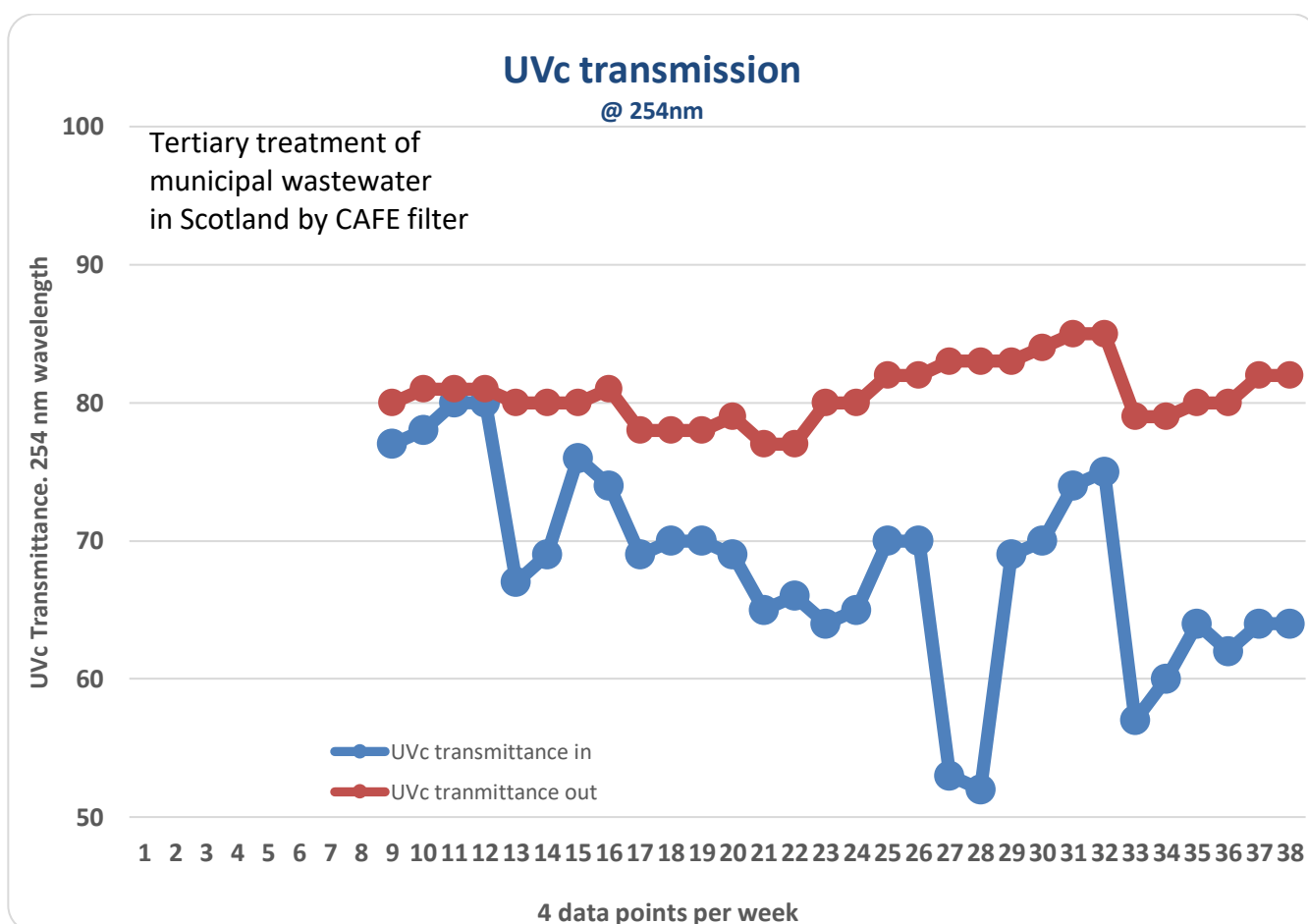
Innovate or die

CWW is a team that isn't going to stand still and watch the grass grow - we are exploring technologies to compliment our CAFE and make it easy and affordable to have high standards. We should, and must, 'polish-up' wastewater to the very best of our abilities.

We are looking at advanced photo-oxidation, oxidation with ozone and other processes and are keen to partner with anyone working on this aspect of treatment. One of our favourite water quality parameters is clarity which helps us see how well UVC (Ultra Violet Light) light can pass through water and therefore UVC treatments will be more effective at destroying toxic chemicals.

When applying UVC, achieving excellent water clarity is often a forgotten stage in the treatment design. The greater the clarity, the more effective the oxidising performance of UVC.

The following graph shows the transmission of UVC (254 nm light wavelength) through the wastewater before and after it was filtered by our CAFE filter.



What we have witnessed during our year of testing is that, our CAFE filter turns turbid water into almost crystal-clear water and substantially improves the UVC transmission of the water. It is easier to apply and cheaper to run advanced photo-oxidation or other oxidation process on final effluents with clean water.

If water treatment is a public health matter, then we must now move to raise the standard of all water treatment systems and do 'no harm' to public health or to the environment/biodiversity.

- the CAFE filter is now available – get in touch if you want to know more about our product or want to be a licensee.