# AFM Water Treatment — Life & the Environment

## Executive Summary

AFM (Active Filter Media) is a water filtration media manufactured from recycled glass bottles and used as a direct substitute for sand in sand filters. In sewage treatment works and even drinking water and swimming pool filters, bacteria will colonize the sand, and after a few days they will start to produce a sticky alginate coat that prevents the filters from working properly. AFM actively prevents bacteria growing, so the performance of the filtration systems are maintained.

AFM can almost eliminate pollution by improving the quality of sewage effluent by 90%. AFM will also improve the quality of drinking water by removing 30% more waste from the water. The public heath and aquatic environmental benefits are therefore substantial, and at the same time AFM could eliminate all of the waste green glass bottles in the UK.

### Drinking water treatment

The provision of clean drinking water is central to public health and well being in any country. Sand is used for the treatment of most of our water supplies, and in 100% of the systems there will be bacterial growth on the filter media. 80% of our water supplies are treated by Rapid Gravity and Pressure sand filters, the performance of which deteriorate as the bacteria cell biomass in the sand develops. AFM solves the problem and allows the same filters to work much better, the result is cleaner, safer water with a life cycle cost benefit for the Water Companies.

### Wastewater treatment

Most of the pollution entering the aquatic environment and chemicals entering the human food chain are derived from aquatic pollution such as sewage effluent and industrial wastewater. Sand filters can treat the wastewater but they are rarely used because the very rapid growth of bacteria in the nutrient rich water makes it difficult to keep the sand working. AFM actively resists bacteria so the problem is eliminated, this allows conventional sand filters using AFM media to work in wastewater.

*Dr. John Hargreaves (Chief Executive Scottish Water PLC) & The Minister for the Environment Mr.Ross Finnie MSP, with AFM*

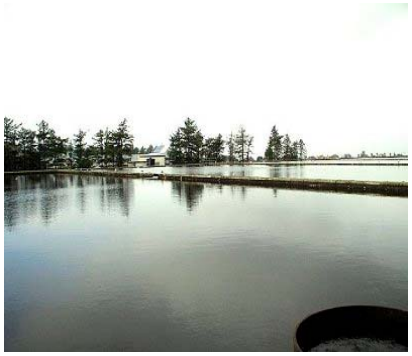
In sewage effluent, AFM will consistently remove in excess of 90% of all the contaminants, including toxic chemicals. Industry and the Water Companies now have a simple, low cost tool, that that can be used to eliminate the majority of our aquatic environmental pollution. The public health benefits and ecological implications for Life and the Environment are substantial.

Dryden Aqua Ltd
Butlerfield, Bonnyrigg, Edinburgh EH19 3JQ.
Tel +44 (0) 18758 22222 Fax +44(0) 18758 22229
www.AFM.eu

# Drinking Water Treatment AFM

Most of the drinking water in Europe is treated by sand filtration, the main filter types are as follows.

1. slow bed filtration
2. rapid gravity filtration
3. pressure filtration



***S***low filter

*Rapid Gravity Filter (RGF)*

*Pressure filter*

Slow bed sand filtration accounts for approximately 20% of all the drinking water systems in the UK, but the process is being phased out in favour of rapid gravity filters which take up less space.

Slow bed filters work biologically, bacteria and other organisms living in sand remove and metabolize the contaminants. The sand is therefore acting as a support substrate for the bacteria and once a stable ecology has developed, slow sand filters can provide an excellent water quality.

Rapid gravity filters operate at water flow rates up to 50 times faster than slow bed sand filters, but the sand is still subject to bacterial fouling. At the high flows, bacterial cell biomass and cell wall debris are washed out of the sand bed. A stable bacterial ecology can not develop due to the rapid flows and aggressive back wash cleaning regime. The bacteria produce copious quantities of alginates in order to stick onto the sand, this is called bio-slime. The alginates promote the growth of more bacteria which binds the sand grains together. Over a period of few months the bacteria will proliferate throughout the filter bed, leading to coagulation of the sand and channeling which permits unfiltered water to pass straight through the filter bed.

Bacteria are required for the proper performance of slow bed sand filters, but in rapid gravity and pressure filtration systems the uncontrolled growth of bacteria will impact on the performance of the sand. In swimming pool systems the water is chlorinated to at least 0.5mg/l free chlorine yet bacterial levels of several hundred thousand to millions will develop on every gram of sand. Most drinking water sand filters are not pre chlorinated, indeed if they were chlorinated the chlorine would react with the bacteria and organics in the filter bed to form organo-chlorine compounds that are toxic and carcinogenic. Bacterial levels in rapid gravity drinking water sand filters can therefore be very high.

Dryden Aqua Ltd,
Butlerfield, Bonnyrigg, Edinburgh EH19 3JQ.
Tel +44 (0) 18758 22222 Fax +44(0) 18758 22229
www.AFM.eu

# AFM in drinking water filters

Trials conducted in England confirmed that AFM removed 30% more waste than an equivalent sand filter working at the same time on the same feed water. Trials conducted in Scottish Water on a high quality supply, also confirmed that AFM would perform better than sand. In the case of Scottish Water, the water was already of a very high standard entering the filters and the main difference in performance between the sand and AFM was attributed to the AFM removing more sub micron particles, ferric and manganese.

*Drinking water treated by sand and AFM media, note the visibly clearer AFM water on the right*

In countries with warmer water than the UK, the growth rate of bacteria will be accelerated, it is therefore anticipated that the performance benefits gained from using AFM will be even greater.

Drinking water quality will be improved by using AFM, and the risk to the public from contracting water borne infection or a toxicological reaction is reduced. Leading environmental consultants ENTEC quote *"Any reasonable cost premiums incurred in using AFM in preference to traditional media will be inconsequential if the media proves itself as a robust means of treating water where there are acute quality problems, e.g. high levels of TriHaloMethanes (THMs) or presence of Crytosporidium. In such instances, the costs of installing AFM will be far less than alternative options involving investment in new and costly processes such as ozone and UV treatment."*

We know that sand filters occasionally discharge retained solids and bacteria back into the drinking water. The bacteria also cause channeling through the filter bed, which allows solids as well as cryptosporidia oocysts to pass through into the public water supplies.

In order to improve the performance of the sand, flocculent such aluminum is used to clarify the water. The aluminum salts coagulate the solids making the particles larger and easier for the sand to remove. However due to the channeling caused by bacteria living in the sand, some of the aluminium will pass through the sand and enter the public water supplies. It has been reported that aluminium may be a trigger for Alzheimer's.

Chlorine is added to drinking water, however the chlorine reacts with bacteria in the sand filters and contaminants in the water to form carcinogenic chemicals (THM`s). The demonstration trials have confirmed that AFM filters do not dump retained solids and bacteria into the water and that AFM will remove at least 30% more waste from the water. The results confirm that less chlorine and coagulants will be required, and that the chemical concentration will be lower in the product water when AFM is employed.

AFM is a low cost solution that will help the water companies to comply with the EEC water quality directives 98/83/EC with no capital expenditure on infrastructure except for the replacement of the sand with AFM. The water quality will be improved by up to 30%, there will be Life Cycle cost benefits for the Water Companies and public health will be protected.

Dryden Aqua Ltd,
Butlerfield, Bonnyrigg, Edinburgh EH19 3JQ.
Tel +44 (0) 18758 22222 Fax +44(0) 18758 22229
www.AFM.eu

# Swimming Pool Industry AFM

There appears to be a public health issue in the swimming pool industry of the UK. The problem has been reported on numerous occasions in the media, however no remedial action has been implemented. We recommend that there should be an independent investigation to determine the true extent of the problem.

## Infectious disease

It is estimated that there are in the order of 4000 cases of cryptosporidiousis among the public as a direct result of visiting a swimming pool. The figure is an estimate, it might be a great deal higher. The cryptosporidia will cause a disease similar to serious food poisoning. A healthy person will be debilitated for several days, however the disease can be grave for the elderly, infirm or infants. In addition to the cryptosporidia, there can be high transient concentrations of human pathogenic bacteria, viri, fungi and parasites. The incidence of swimming pool related transmission of disease has not been quantified, but it is likely to be as high as 20,000 cases per year in the UK

Sam Lister, Times Health Correspondent 2004***, A year-long survey by the Health Protection Agency of 88 health clubs found that 26 per cent of the baths contained legionella bacteria.*** *About 300 cases of the disease are reported in England every year and it kills between 30 and 40 Britons annually.*

## Chemical issues, cancer and respiratory disorders

We know that chlorine reacts with waste in the water to form chemicals that burn your eyes, cause cancer and damage your lungs. Recent research supported by the European Commission also shows that the atmosphere above the pool water can initiate asthma in children and may cause other serious respiratory disorders. The pool water quality criteria in countries such as Germany are much tighter that they are in the UK. Considering that the level of asthma in the UK is the highest in Europe with 20% to 30% of the teenage population suffering from respiratory problems. We should perhaps question the safety of exposing children and adolescents to poor quality swimming pool environments. Swimming has been compared to being as healthy as smoking a pack of cigarettes, while it may not be quite as bad as this statement, should we wait for 20 years until it is fully quantified, or do we act now?

## Reason for the problem in swimming pools and a solution

There are many reasons for poor water quality and atmosphere in the UK swimming pool industry. AFM research has shown that sand will incubate bacteria in the filter. The bacteria reduce the performance of the filter by allowing pathogens to pass through the filter to the public. Pathogenic bacteria are also produced by the sand filter and discharged into the pool. The high concentration of bacteria also consumes the chlorine to forms toxic chemicals. Simply changing the sand filter media to AFM will resolve many of these problems.

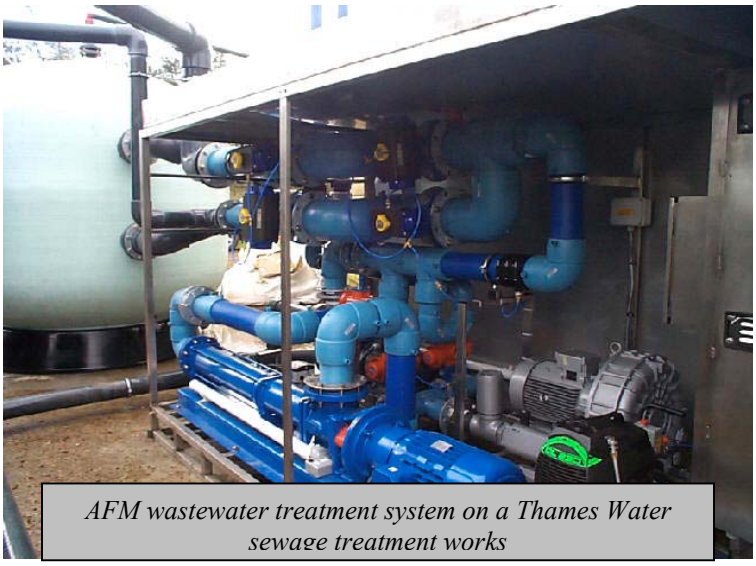
Recent data shows that a public pool using AFM can have atmospheric quality and water quality 50 times better than a standard public swimming pool. While the public health issues with regards to swimming pools have not been fully quantified, we have in the form of AFM media a simple means by which they can be improved. In addition, the added cost of the AFM is paid back in a matter of months by savings in chemicals.

Dryden Aqua Ltd, Butlerfield, Bonnyrigg, Edinburgh EH19 3JQ
Tel 018758 22222 Fax 018758 22229,
www.AFM.eu

# Wastewater treatment AFM

## Effluent treatment

The majority of aquatic pollution to rivers, lakes and the sea is derived from industrial pollution and sewage effluent.



*AFM wastewater treatment system on a Thames Water sewage treatment works*

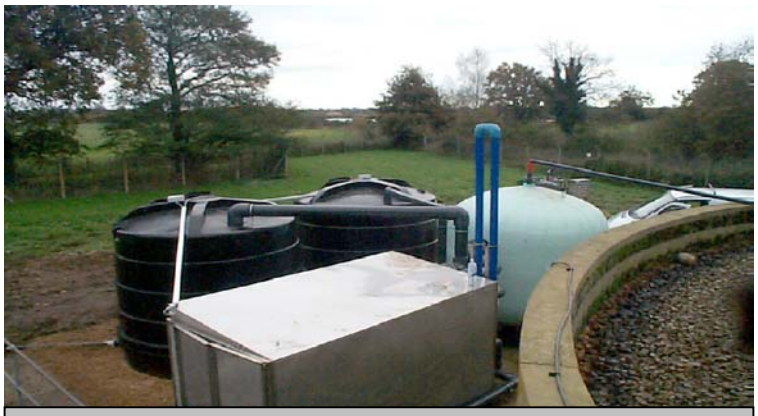
The UK Royal Commission Standards on sewage effluent water quality were set in 1912 at a 20:30 standard. This means that the maximum levels are; 20mg/l BOD (Biological Oxygen Demand) and 30mg/l suspended solids. Many sewage works in the UK have discharge limits set at the Royal Commission standards or at higher levels.

Over the last 40 years, the number and type of chemicals used by the public and industry have increased exponentially. This has resulted in a chemical cocktail being discharged to wastewater treatment works and the environment. The chemicals include PCB`s (polychlorinated phenols) and toxic metals plus thousands of other products. Many of the chemicals are not broken down by the sewage works, and even if they are discharged below detection level, they can still be bio-accumulated by the marine ecosystems, this is the reason why high levels of PCB`s are found in fish in the North Sea. The solids discharged from sewage works are predominantly bacterial cells which can bio-accumulate the toxic chemicals. If the solids can be removed from the effluent, then many toxic chemicals will be removed at the same time.

Trials and full scale systems

Trials with AFM and full-scale systems have been installed in sewage treatment works with;

Scottish Water
United Utilities
Thames Water
Northumbrian Water



*AFM tertiary treatment for sewage effluent, 50 cubm/hr 100mg/l suspended solids levels reduced to less than* **5mg/l**

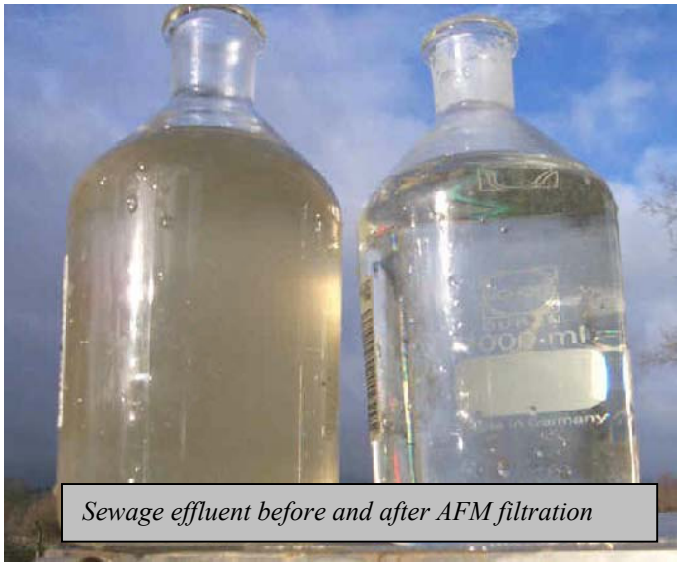
Industrial trials have progressed with Ford Motors PLC in England, Spain and Germany. The focus was on solids removal, however by removing the solids and bacteria from the water, the BOD, as well as the toxic chemical component can all be reduced.

AFM filtration media is used in a good quality Rapid Gravity or Pressure sand filters, and many companies across Europe manufacture the equipment. However, very few sewage or industrial effluent systems employ tertiary treatment for the removal of solids. Sand filtration has not been developed because the high level of nutrients and bacteria in the wastewater, rapidly block the sand making the systems difficult to manage and maintain. There are few economic options available to Water Companies and industry that will allow them to treat wastewater to a high standard. Biological membrane systems are one option, the systems are effective, but they are also expensive and difficult to operate. However when AFM media is used, as opposed to sand, the media

Dryden Aqua Ltd,
Butlerfield, Bonnyrigg, Edinburgh EH19 3JQ.
Tel +44 (0) 18758 22222 Fax +44(0) 18758 22229
www.AFM.eu

can cope with the wastewater and remove 90% to 95% of the solids and chemicals, as well as reducing BOD. AFM media therefore provides a practical low cost solution to the water industry that can be applied to all sewage effluent discharge streams, as well as industrial wastewater.

AFM pressure or rapid gravity filters can be fitted onto the back end of sewage works. The trials and full-scale systems have all confirmed that AFM can be applied to sewage effluent. The photograph shows a rather poor effluent water quality with a solids content of approximately 70mg/l. After AFM filtration, the solids content was reduced to less than 3mg/l and BOD was reduced by 90%, and the toxic chemical TBT (Tri-butyl Tin) was reduced levels below detection. The dissolved organic content of the effluent was also reduced to give and effluent stream that was clear and bright.



*Sewage effluent before and after AFM filtration*

The Royal Commission Standards of 1912 were acceptable up until the 1960`s, however they do not take into account the higher level of chemical toxins now being discharged into the environment. The chemicals accumulate through food chain amplification, and return back to the public in fish, and animal products that have been fed fishmeal. The Urban Wastewater Treatment Directive (Directive 91/271/EEC), Dangerous Substances Directive (Directive 76/464/EEC) and freshwater Fish Directive (78/659/EEC) will tighten discharge water quality standards, and AFM provides a means that will allow the Water Companies to comply with the new standards.

Water companies provide an excellent service and have achieved major improvements over recent years, however sewage works are still the principal source of aquatic environmental pollution. AFM now provides the water industry with the tool by which they can implement low cost high performance tertiary effluent treatment and comply with the new EEC water directives. The project has confirmed that AFM has the potential to reduce aquatic environmental pollution by 90% and make huge improvements with public health, Life and the Environment

Dryden Aqua Ltd,
Butlerfield, Bonnyrigg, Edinburgh EH19 3JQ.
Tel +44 (0) 18758 22222 Fax +44(0) 18758 22229
www.AFM.eu