

# AFM filtration and pool standards

By Dr.Howard T Dryden

## AFM technical history & disinfection by-products

Dr.Howard Dryden of Dryden Aqua conducted a PhD on zeolite sand filtration for the fish farming industry in order to control solids and dissolved nutrients such as ammonium. Considering that there could be several million fish in a system and all the water is recycled, it is very important to get the technology right. There is no room for error, if the systems starts to fall down then fish could die within a few minutes. As a Marine Biologist Dr. Dryden also helped develop the systems and technology to support the health and well being of dolphins and killer whales in chlorinated system in zoos and water parks. In nature, dolphins live for some 50 years, but in captivity they usually succumb from lung damage, pneumonia or brain damage from the chlorine disinfection by-products within as short a period as 10 years.



While we do not agree with keeping dolphins in captivity a research project was established to determine the mechanisms by which chlorine disinfection by-products are formed in an effort to try and improve the living conditions for the animals. It is only once you understand that mechanisms that you can develop the procedures to control the quality of the water. The research was successful and Dryden Aqua managed to reduce the noxious chlorine disinfection by-products by up to 95% and essentially eliminated the production of nitrogen trichloride. Dolphins, killer whales, seals, penguins, otters, manatees, dugongs and hippos now have a much healthier, safer and cleaner habitat in many zoos and water parks around the world as a consequence of Dryden Aqua research.

Given that Dryden Aqua had solved many of the water quality problems in zoological enclosures our attention then turned to humans and the swimming pool industry. In the aquaculture and zoological industries, if you identify a problem, the problem is eliminated and there is never any debate. However in the pool industry, this philosophy does not seem to apply, problems have to be examined, studied, quantified, re-examined and then completely ignored. At Dryden Aqua we do not agree with this approach, if a problem can be solved then we just proceed, institutes and research laboratories can then spend the next 20 years examining how bad the problem would have been. We know there are biohazard risks, and we know there are air quality health issues from nitrogen trichloride and THMs and we know how to solve these problems, so why not?



## Research

Dryden Aqua research developed the technology to manufacture zeolites from glass as a raw material. A 1.2 million Euro Research project in cooperation with the European Commission under the Life Environment initiative and WRAP (Waste resource action program) in the UK helped to further develop and optimize the process. AFM is not a zeolite, but zeolitification technology is used to change the molecule shape and structure on the surface of the glass.

The raw glass materials used for the manufacture of AFM are a combination of virgin grade glass and glass manufactured by Dryden Aqua, AFM is not a waste recycled glass product. The chemical composition of the glass in AFM has been changed to give the filter media surface active properties, similar to the self cleaning action of some windows and the self sterilizing properties of the paint used in operating theaters or food process factories.

Dryden Aqua is perhaps the only marine biological company dedicated to water treatment in the entire swimming pool industry. As such we have an insight into the biological, biochemical and chemical mechanisms of water treatment that would not be apparent to chemists or engineers. This knowledge and 20 years of research on sand and aluminosilicate media allowed us to develop the surface active properties of AFM. AFM rejects the growth of bacteria but adsorbs dissolved organics and ammonium. AFM cannot be compared to a basic crushed glass product, it would be like trying to compare anthracite filtration media to activated carbon, both products are made from carbon, they are chemically identical yet they have fundamentally different properties.

### AFM performance & case study

AFM is manufactured by Dryden Aqua and is only distributed through reputable companies in the swimming pool industry. We now have some 40,000 installations around the world; however AFM is only part of the Dryden Aqua Integrated process. AFM will work well, but when used as part of the Dryden Aqua Integrated system, we can now guarantee to reduce chlorine consumption in any public pool in the UK by 70% to 90%. The cost of the installation can usually be recovered out of revenue savings in chemicals and water in less than 18 months. Indeed we are now



Dutch Olympic swimming team get behind AFM

investigating the possibility of providing public swimming pools with system up-grades to bring them into compliance with the German DIN standard while keeping it cost neutral for the pool operator. A major swimming pool in England is under detailed investigation and will be reviewed by the German authorities as a possible strategy to be applied in Germany as a means of reducing costs and to comply with tighter standards. A detailed peer reviewed report will appear over the next few months, but we can confirm a 70% reduction in chlorine, elimination of inorganic combined chlorine and compliance with the most stringent water and air quality standards while saving the pool around 50% of their operating costs.

### Pool standards

The UK is the only country in Europe that does not have any formal swimming pool water quality standards or product certification. This has led to unscrupulous companies providing products to the UK pool industry that are either ineffectual, or are potentially dangerous. In this context we agree with all of the comments expressed by Chris Carr of the Institute of Swimming Pool Engineers in relation to the health & safety and performance issues associated with crushed glass products. The use of such products raises greater issues for the UK pool industry in relation to occupational as well as public health and safety.

The UK has 10 and 20 times more cryptosporidiosis disease incidents than Germany and other countries that operate in compliance to the DIN standards. Figures from PWTAG, HPA (health protection agency) and Euro Surveillance estimate the number of cases in the UK pool industry at around 3500 cases every year. Cryptosporidiosis is a very debilitating parasitic infection that can be fatal to the elderly or immune depressed individuals. The fatality rate is approximately 1 in 400. In addition to parasitic infections we also have much higher levels of bacteria such as Legionella which can be

attributed directly to poor water treatment, lack of standards and poor hygiene. In compliance to the UK guidelines there can be up to 50 pseudomonas bacteria per 100ml of water, under the DIN standards the upper acceptable level is less than 1 in 100 ml of water. If we look at water quality, there can be up to 1.5 mg/l of combined chlorine in a UK pool, but the upper limit under DIN is 0.2 mg/l. We know that THM's are extremely toxic, and levels can reach over 300 ug/l when water is exposed to sunlight of UVc light. The upper guideline limit in UK is 100 ug/l but it is rarely measured, the concentration in the air above the water is never measured, yet it is a legal requirement to maintain concentrations below 20 ug/ l in water under DIN, and in France when UV irradiation is used the THM level must be measure in the atmosphere.

The UK HSE (Health & Safety Executive) state that if there is no formal WEL (work exposure level) then it becomes the responsibility of the pool operator to prepare a COSHH risk assessment for chemicals such as nitrogen trichloride or chloroform in the water or air. These issues are not covered under the UK guidelines so perhaps it is time the UK adopted formal standards such as the German DIN standard. Technically you could argue that the UK public pool industry is in non-compliance with their statutory health and safety obligations, the adoption of a formal standard would bring the UK into compliance with the rest of Europe.

### **PAWS (Pool Air & Water Standard)**

There are clearly greater health and safety issues associate with the UK pool industry in comparison to the rest of Europe, the lack of standards and poor quality products has resulted in much higher running costs for UK swimming pools. In an effort to address these problems Dryden Aqua developed the PAWS standard which is a combination of the German DIN standard, the French decrees in relation to air quality in pools and also the European drinking water directive. Quality standards are often taken from the drinking water regulations, with the assumption that if it is safe to drink then it is safe for swimmers, this assumption is not correct. The greatest chemical danger to bathers is not water quality but air quality just above the surface of the water, so the key water quality parameters are the volatile gases such as nitrogen trichloride, cyanogens chloride and the THM chloroform. This is why the DIN and PAWS standards have a maximum limit of 20 ug/l for THMs in pool water yet the limit is 100 ug/l in drinking water.

The use of poor quality products such as crushed glass, non DIN standard filters, poor quality or contaminated chemicals used in a non optimized water treatment systems has created an industry in the UK that is expensive to operate and a greater health and safety risk to staff as well as the public. It is the mission of Dryden Aqua to try and solve these problems and a good starting point would be for public pools in the UK to review the German DIN standards or the Dryden Aqua PAWS standard and to start working towards compliance with a formal standard as opposed to a guideline.

There is scope for the UK to modify and adapt existing pool water treatment systems to bring them into compliance with PAWS. There are many reputable and good companies in the UK, but above all we need professional support and training of pool plant operators. It is only through education and support can we raise the standard and make pool operators aware not only of the risks but of the major benefits that can be achieved by using good quality products in a properly integrated and well managed water treatment system.

