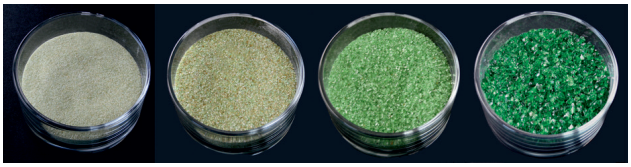
AFM®

Activated Filter Media

Independent performance test results, July 2014*



Introduction

The following report summarises the performance test results of Dryden Aqua AFM®, quartz sand and other glass filter media commonly on the market. All work was conducted by IFTS (Institut de la Filtration et des Techniques Séparatives www.ifts-sls.com) in France. IFTS is recognised as the leading independent accredited laboratorie in Europe for the water industry specialising on water filtration media. All tests were conducted under strict ISO procedures.

AFM® is a highly engineered filtration media manufactured from green container glass as a raw material.

Review of data

Three factors are important in media bed filtration:

1. Mechanical filtration

2. Adsorption reactions

3. Performance with coagulation and flocculation

The following report relates only to the mechanical filtration performance.
The tests were conducted on clean media. It is known that sand and non-activated crushed glass media will become a biofilter over a period of a few months. The bacteria adversely affect mechanical filtration performance and promote wormhole channelling. Bio fouling and there for channelling does not happen with AFM®.

Filter media tested

Products tested were as follows:

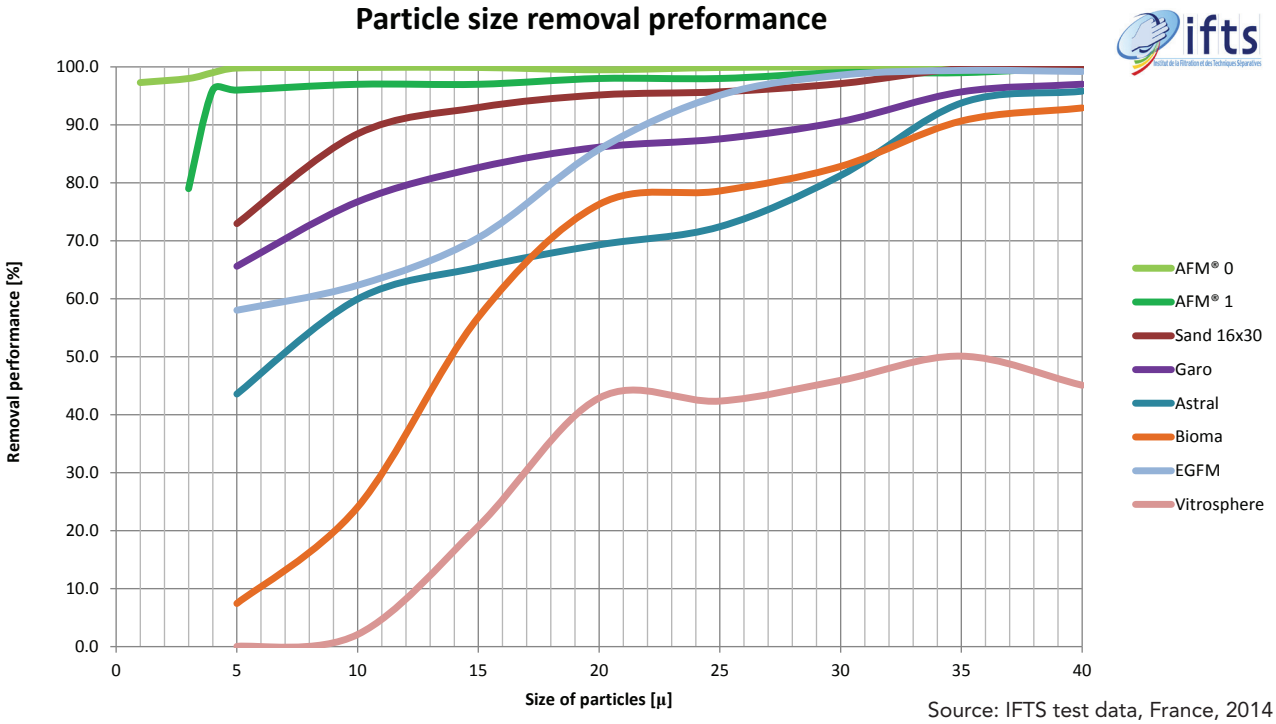
- AFM® Dryden Aqua, Scotland
- Quartz Sand from the Leighton Buzzard deposit, England
- Garofiltre crushed glass media, France
- EGFM by DMS crushed glass media, England
- Bioma crushed glass media, Spain
- Vitrosphere spherical glass balls, Germany
- Astral crushed glass media, Spain

***Tests conducted by IFTS: www.ifts-sls.com**

Test 1: Particle size removal efficiency

AFM® 1 will remove more than 95 % of all particles in the water down to 4 microns. The best a very high quality sand or other glassand can achieve is 20 microns at an efficiency of 95 %. AFM® 0 is able to remove particles down to 1 micron at an efficiency of more than 95 %. AFM® 0 has been developed for best filtration where flocculation cannot be used.

The results were collected from filters operated at 20 m/hr (8 gpm/ft²) filtration velocity with no flocculation. Therefore the results are a direct comparison between the different filtration media. At slower water flowrates the results for AFM® improve exponentially



Source: IFTS test data, France, 2014

Graph 1: Particle size removal efficiency at 20 m/hr (8 gpm/ft²) velocity and no flocculation

Summary of filter media performance at 1 and 5 microns, water flow 20 m/hr

		AFM® 0	AFM® 1	Sand 16 x 30	Garo	Astral	Bioma	EGFM	Vitro-sphere
Efficiency at 1 microns Removals [%]	**Average [%]**	97.28	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Efficiency at 5 microns Removals [%]	**Average [%]**	99.79	96.02	72.97	65.61	49.35	7.45	58.03	0.05

n/a = not applicable for filtartion at the stated micron size

Source: IFTS test data, France, 2014

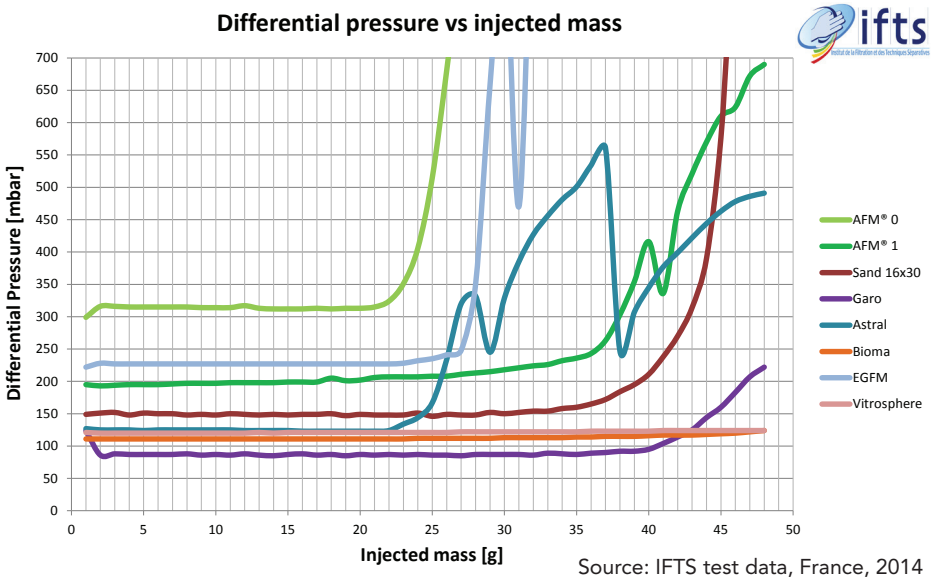
Comments

AFM® was the most effective filter media, the data confirms AFM® 1 removed 96.02 % of all particles down to 5 microns, and the equivalent grade of sand only achieved 72.97 %. AFM® 0 achieved 97.28 % at 1 micron at 20 m/hr (8 gpm/ft²).

Test 2: Differential pressure vs Injected mass

ISO CTD particles were injected into the process water to test the capacity of the media to remove particles from the water. As the particles are removed from suspension, pressure should gradually build up in the filter. Media such as the sperical Vitrospheres remained flat because most of the particles simply passed through the filter bed. Media such as Astral were very unstable and dumped retained solids back into the water.

Ability to retain particles is very important in any filtration system. In drinking water and swimming pool systems, where crypto-sporidiosis presents a significant disease risk, filters must be stable and able to retain parasite's. Sand and AFM® were the only two products to offer a stable filtration barrier.



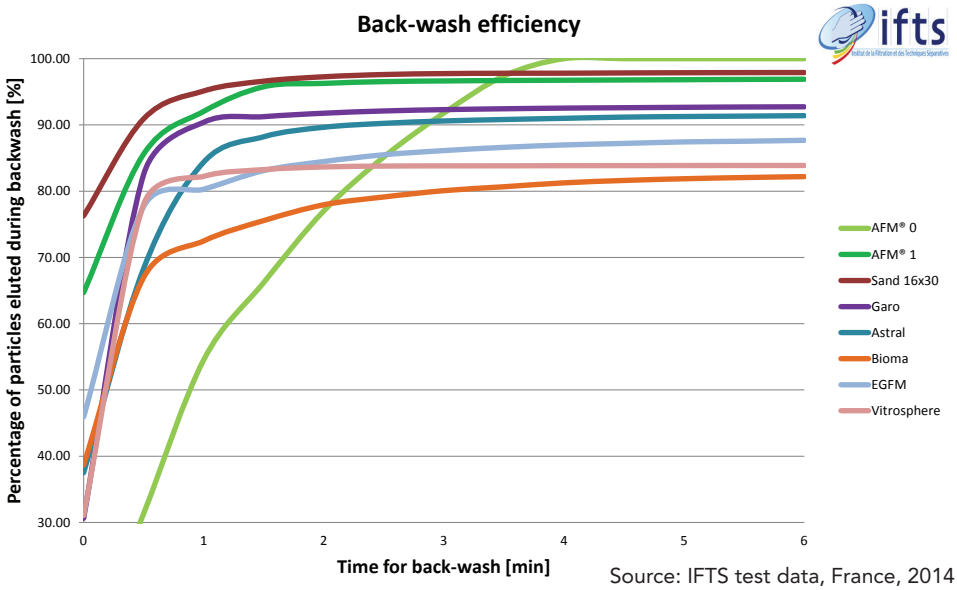
Source: IFTS test data, France, 2014

Graph 2: Differential pressure vs injected mass

Test 3: Backwash efficiency

The quantity of material released over time was measured for each of the various media. The graphical data for backwash efficiency confirms that both sand and AFM® 1 achieved 97 % backwash efficiency, AFM® 0 achieved 100 %. The closest glass media was Garofiltre at 93 % followed by Astral at 92 % and EGFM at 88 %.

What goes into a filter must come back out, if this does not happen the retained organic matter will be sub-jected to bacterial metabolism and eventually the filter media will bio-coagulate due to an accumula-tion of alginates secreted by bacteria and mineralised biofilm layer.



Source: IFTS test data, France, 2014

Graph 3: Back-wash efficiency

Result discussion

1. AFM® performed the best in tests, more than twice as good as sand or any of the crushed glass products. It is easy to remove large particles but it is the sub 5 micron that are difficult to remove and in this particle size range AFM® excelled (see graph 1 & table page 2)
2. None of the glass products tested backwashed within 6 minutes, the best still retained 8 % of solids, and the worst retained 20 %. This translates to a significantly higher water requirement for backwashing and a higher chlorine demand resulting from retained organic matter (see graph 3)
3. The chemistry of the glass, the particle shape and especially the activation process give AFM® the important properties to clearly out perform sand and glass sand filter media .The large surface has a strong negative charge to adsorb organics and small particles. The surface also has metal oxide catalysts which produce free radicals and thus a high redox potential. Therefore AFM® is self-disinfecting. AFM® prevents bacteria from settling to make it a unique, bio-resistant filter material.

Application

- **Drinking water:** ferric, manganese, arsenic, chromium, TBT and a range of heavy metals and priority chemicals
- **Filtration prior to membranes and desalination:** filtration performance at least twice as good as sand, in most cases the SDI (Silt Density index) will be reduced to under 3
- **Swimming pool water:** private, public, water parks and large scale lido systems
- **Aquarium Life Support systems:** marine and freshwater system, as well as marine mammal and bird systems
- **Tertiary treatment of waste water:** municipal and well as industrial waste water, AFM does not biofoul so it is perfect for these applications

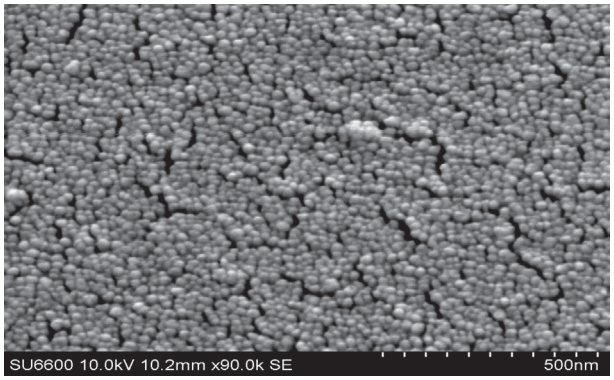
Additional information: What is AFM® activation?

AFM® activation is a patent protected 3-stage process during which the surface structure of the glass is changed at a molecular level. Glass is an aluminosilicate, the activation process uses the existing properties of the glass which is why Dryden Aqua only use green container glass. In addition the production process enhances the glass' properties by:

1. Increasing its catalytic properties

2. Controlling its surface charge density

3. Increasing its surface area



AFM® surface

NSF/ANSI 61

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