

# EFFECTIVE CONTROL OF BIOFOULING ON RECIRCULATING AND SINGLE-PASS, WATER-BASED FILTRATION SYSTEMS



“ FIRST CLASS SERVICE WORLD CLASS FILTERS ”

## THE PROBLEM

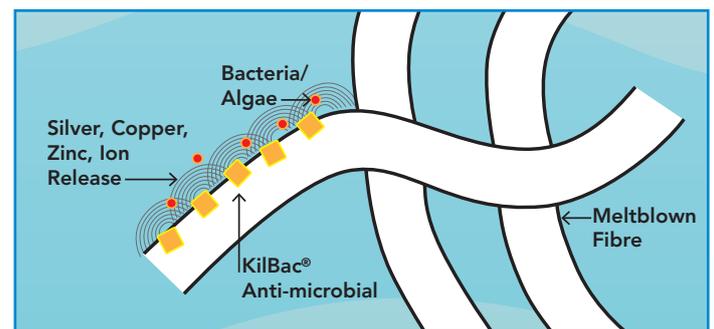
In many water-based processes, across diverse industries, there can be a persistent problem with microbial contamination and the subsequent biofouling of the filtration system. Filters used to protect processes and membrane separation systems can quickly become a breeding ground for the contamination. This can manifest itself as physical blockage of the filter, increased differential pressures and the subsequent release of concentrated microbial contamination into the down-stream process. This in turn can accelerate the biofouling of separation membranes, process pipework and heat exchangers.

Amazon Filters have developed **KilBac®** fibres that are produced by meltblowing polymers that are compounded with various antimicrobial technologies. **SupaSpun KilBac®** and **SupaGard KilBac®** are available for inhibiting growth of both bacteria and algae and are available in absolute and nominal rated efficiencies to match specific applications.

## THE TECHNOLOGY

Nanoparticles of silver are often used to confer anti-microbial properties to a polymer. However, the size of these particles means that when compounded before fibre production, a high percentage of them are embedded within the fibre and only a very small percentage are exposed to the water being filtered. This significantly reduces the efficacy of the silver.

At **Amazon Filters** we utilise micron sized zeolite particles that contain the active silver, zinc and copper. These are compounded with the base polymer and the fibre size is controlled during the manufacturing process to maximise the surface area exposed of the active ingredient being exposed to the water being filtered.



Active elements are matched to the application. For anti-microbial applications a combination of Silver and Zinc is used. For anti-algal applications a combination of silver and copper is used. Combining the two metals in one has a synergistic effect that can significantly increase the effectiveness of suppressing growth on the filter.

## EFFICACY ON ALGAE

A number of internal studies have been conducted to assess the efficacy of the treatments with various microorganisms. Biofouling with algae can happen quickly in both seawater and fresh-water applications and it also gives a very visual indication of contamination. Tests performed on microalgae *Chlorella sp* demonstrated the importance of selecting the right additive. Optical density of the liquid ( $OD^{686}$ ) was used to estimate the growth or death of the algae in the test flasks. Results showed excellent anti-algal properties from the Ag/Cu additive while a competitive additive based on Ag nano-particles had insignificant effect on algal growth. The test solution was measured initially, then over 15 subsequent days.



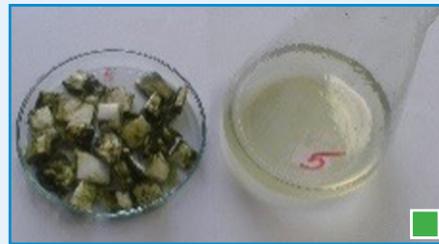
Initial concentration of algae in flasks

### Treated with Ag/Cu : SupaSpun 04A



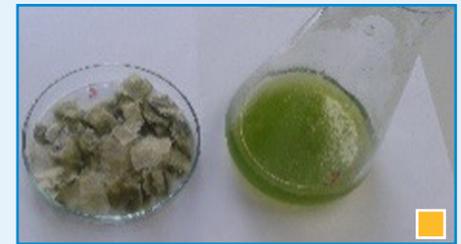
- The algae had been removed from the water and the algae collected on the filtration material had been killed.
- Arresting the growth results in significantly reduced blockage of the filter and longer operating lifetime.

### Untreated Polypropylene filtration media



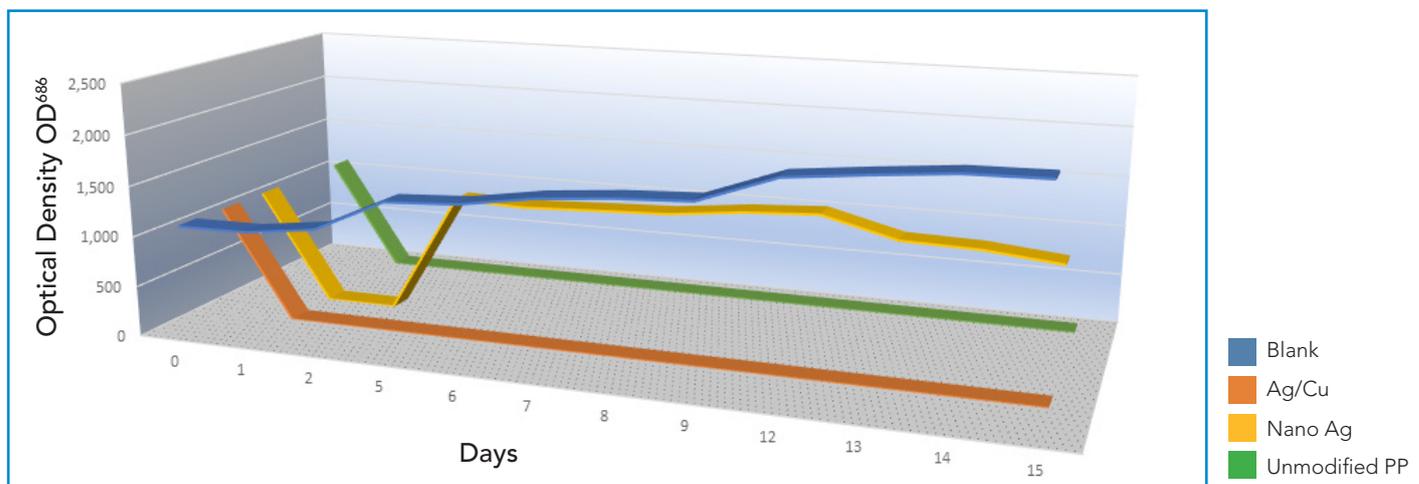
- The algae had been removed from the water but it had instead grown on and through the filtration matrix.
- This would lead to blockage of the filter and also potential detaching of algae onto the downstream side leading to gross contamination of the membranes and process.

### Treated with Nano Ag



- There was little effect on the algae concentration in the water and there was evidence of growth on the filtration media.
- This demonstrates the importance of choosing the correct antimicrobial as well as the format i.e. micron vs nano.

## CHANGE IN OPTICAL DENSITY OF GROWTH MEDIA IN SHAKE FLASK



## EFFICACY ON BACTERIA

Standard ASTM testing has been conducted on the **SupaSpun KilBac® 04B** to demonstrate the antimicrobial effects on

- *S.aureus*
- *E.coli*
- *P.aeruginosa*
- *B.Subtilis*

Test data for *P.aeruginosa* tested to ASTM 2149 is provided in table below.

Sample ID	Zero Contact Time	24hr Contact Time	Percent Reduction
Assay (+)	$4.3 \times 10^5$	$6.2 \times 10^7$	Increase
Assay (-)	<10	<10	N/A
04BP (Silver/Zinc)	$4.3 \times 10^5$	$6 \times 10^1$	99.9999%

In addition to this, tests have been conducted on closed loop systems.



Test conditions:

- *Escherichia coli*
- Initial CFU: 1000/ml
- Flow rate 300 L/h, closed loop
- Medium: PBS + 0,4% glucose
- Medium volume: 15 L, pH: 7,4
- Run time: 120 min

This test showed that the differential pressure across an unmodified filter increase by 500% while the **KilBac®** variant only doubled. Although not an environment that would occur in practice it did give a good indication of the efficacy of the antimicrobial incorporated into the filter.

Additional work on a recirculating system using mains water has also been conducted. It has shown that the **SupaSpun KilBac®** exhibited no increase in differential pressure over a two-week period while inhibiting the general growth of bacteria in the system. This contrasted sharply with an unmodified filter that exhibited a doubling of pressure drop over the same period of time in addition to a proliferation of bacteria in the recirculating water.

## TARGET APPLICATIONS

The **SupaSpun** and **SupaGard KilBac®** filters are applicable to any water-based application where microbial / algal growth and subsequent biofouling of the filtration media is evident.

- Seawater applications: prefiltration systems for protection of SRP membrane for injection water in Oil & Gas exploration.
- Any process water system where intermittent flow is possible leading to stagnant conditions.
- Filters used in side-stream applications within building services on LTHW, CHW and condensate circuits.
- Condensate filtration in power generation.
- Prefiltration to hospital equipment such as endoscope washers.

## THE CONCLUSION

The **KilBac®** filtration media is effective in reducing or eliminating biofouling on filters, subsequent blockage and detachment of concentrated contamination downstream. It is possible to extend the life of the prefilters bringing substantial cost benefits as well as protecting expensive downstream membrane systems.

If you have any application that you would like to discuss in more detail please contact Amazon Filters.