APPLICATION NOTE

Improving Jetting Performance on Wide Format Printers Through Optimised Filter Design

AN001

AMAZON FILTERS LTD

SUMMARY

As the technology in industrial inkjet printing advances towards higher definition, with drop sizes down to 1.0pl, the size of the print head nozzle continues to reduce. This poses increased challenges to the bulk ink manufacturers as they try to develop optimised filtration systems to prevent nozzle blockage while not adversely affecting the manufacturing cost.

One global manufacturer of pigment based UV curable inks began to receive reports of reduced or inconsistent jetting performance on piezo heads from its customers using wide format printers. This can have major cost implications including maintenance downtime, rework, and potential replacement of expensive print heads.

Amazon Filters were chosen to work with this global manufacturer to develop a new filter to ensure the removal of the contamination whilst maximising the transmission of the colour pigments.

Following the introduction of the new filter in production, the customers jetting sustainability issues have been resolved.

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INTRODUCTION

Advances in inkjet technology, such as Miniature Electro Mechanical Systems (MEMS), are driving the increased specification of bulk digital ink with respect to tighter classification and particle retention. It has been reported that to prevent nozzle blockage, particulate in the ink should be 100 times smaller than the nozzle diameter. With nozzle diameter's ranging from 10-50 microns this ideal is not always possible especially with milled pigments in the range of 150-200nm.

Unwanted particulate, agglomerate and gels can originate from a number of sources.
Raw materials suppliers, gels generated due to heat excursions during the blending of the formulations, accidental exposure to light that initiate polymerisation as well as poor maintenance of print heads all contribute. Preventing jetting sustainability issues due to nozzle blockage is a balance between maximising the pigment transmission while removing as much of the extraneous contamination as possible.

A COLLABORATIVE APPROACH

Ideally the ink manufacturer would provide details of the ink formulation and the filter supplier would provide the appropriate filter. In reality the complexity of todays' ink formulations means that a collaborative approach is needed to co-develop the most appropriate filter and ensure an optimised solution.

Amazon worked closely with the customer, supplying configurations that were initially evaluated using jetting sustainability trials on Cyan ink. The results were then used to improve the filter performance by modifying the configuration of the filtration layers. Final approval of the filter performance was achieved using particulate analysis of the ink post filtration.

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JETTING SUSTAINABILITY

To qualify the suitability of the ink quality a jetting sustainability trial was conducted on a 800kg batch of Cyan UV curable pigment based ink. This involved continuous jetting for 1 minute and monitoring the number of nozzles dropping out over time. This is not something that would happen in the actual printing process but it gives a good indication of potential problems that could occur for the customer.

Below are some representative jetting maps from the initial prototype filters compared to the original supplier. The white vertical lines indicate individual nozzles dropping out. The few horizontal lines indicate a break in printing.

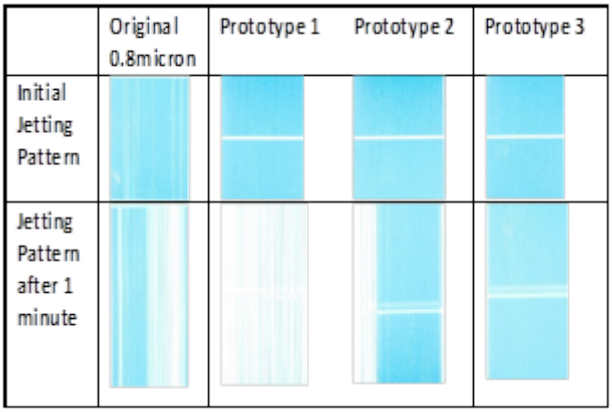
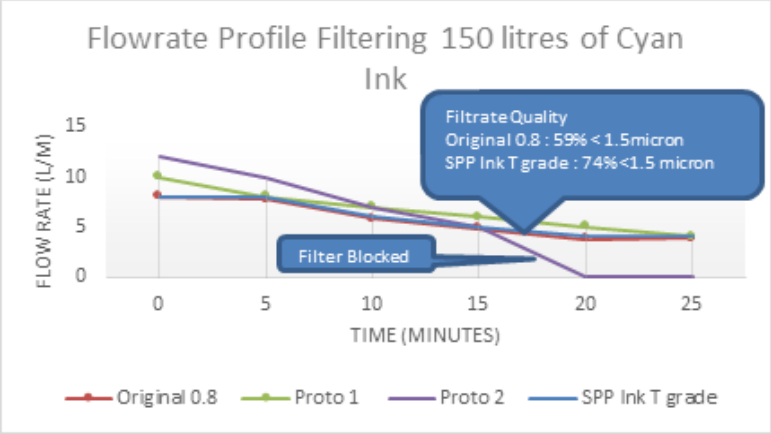


Fig 1: Jetting patterns showing drop out in individual nozzles (vertical white lines)

THROUGHPUT AND FILTRATE QUALITY



In conjunction with the jetting tests the flowrate decay was measured to ensure full batches could be processed in the required time. The profiles indicate the significant variation in throughput dependant of filtration media type and configuration. It also highlights how two filters with the same blocking characteristics can give significantly different filtrate quality. The higher the percentage of small particles the better. The measured filtrate quality could also be directly linked to the jetting performance images produced, giving confidence that a verification of product performance based on filtrate quality, would lead to the resolution of jetting sustainability issues for the customer.

FINAL DESIGN AND VERIFICATION

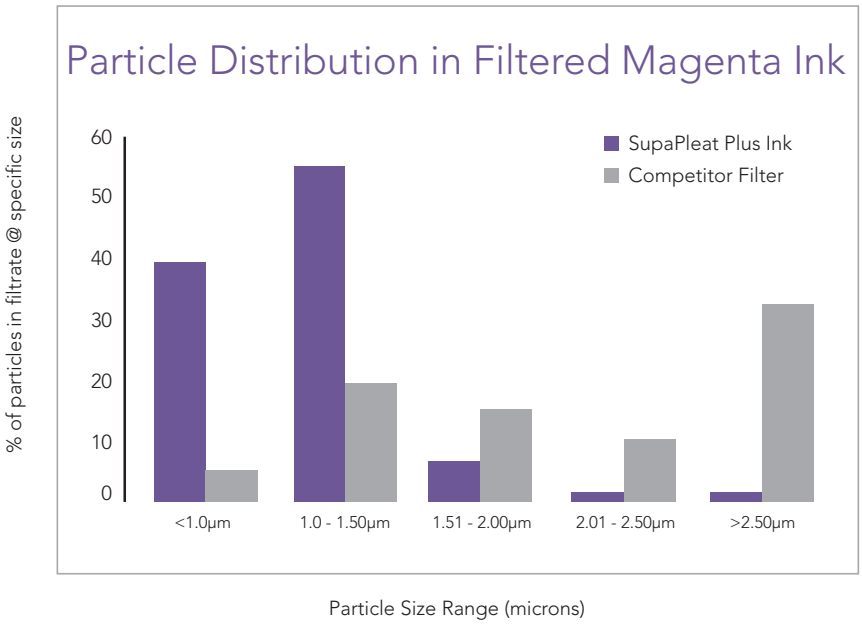
A total of eight filter media combinations were eventually tested to obtain the most appropriate version. Configuration improvements included use of higher loft meltblown materials on the upstream side to maximise the capture of gels and guarantee processing times. Analysis of the viscosity profiles for the various ink colours, Cyan, Magenta and Black resulted in additional development work to improve the separation of pleats to maximise flow and throughput. Particle size analysis was used to confirm the performance of the final variant.

The ink manufacturer decided to concentrate on the filtrate quality below 2.5 microns as a means of verification as this had the most influence on jetting performance.

	% of particles below specified micron size			
	Magenta		Black	
Mastersizer Channel Micron Size	Original 0.8 Filter	New Design SPP Ink	Original 0.8 Filter	New Design SPP Ink
Total no of particles in filtrate sample	686530	423892 **(38 % reduction)**	186760	118826 (34 % reduction)
<1.09	6.14	42.15	20.72	30.24
<1.50	28.63	98.05	69.68	93.35
<2.00	49.73	99.91	86.46	99.88
< 2.50	62.13	99.94	92.05	99.88

n.b Ink diluted to 100:1 to allow particle sizing

The measured filtrate quality demonstrates a significant improvement using the new filter design. There is between a 34% and 38% reduction in the quantity of particulate in conjunction with a significant reduction in the number of larger particles as highlighted in the table above. Displaying the data in a different way more clearly demonstrates the reduction in larger particles in the filtered ink which were causing the jetting issues.



The graph also highlights the often, erroneous nature of assigned micron ratings for filters. The complex nature of inkjet formulations and the presence of specific contaminants such as micro gels means that traditional methods of assigning efficiency using, for example ACFTD, are not always relevant to the actual process. For this reason Amazon Filters have assigned grades to the new SupaPleat Plus Ink range rather than micron ratings. These grades are linked to the ink quality requirements of various printhead technologies and can be used as a starting point for filter evaluation.

CONCLUSION

Through close collaboration with the ink manufacturer and an iterative approach to product design based on customer feedback, the quality and consistency of the digital ink has been substantially improved resulting in the elimination of jetting issues and cost saving due to the elimination of down time on the printer.

As a result of the work conducted during this project, a range of SupaPleat Plus Ink filters have been developed and introduced to complement the existing portfolio for ink filtration from the SupaSpun and SupaPore range. All these filters can be incorporated into the SupaClean range of housings to facilitate the clean change of filters whilst minimising Heath & Safety issues associated with solvent based inks.

For more information on Amazon Filters products and services for Digital Ink refer to publication Industry Capability Guide

REFERENCES

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