



UltraPure® Filter VOC Performance Testing

Background

The UltraPure® filter is designed to remove particulates and volatile organic compounds (VOCs) from the gas flowing into incubators. The gas can be supplied through compressed air cylinders or through gas blenders pulling air from the environment. Therefore it is important to assess the potential contaminants from both sources. Jacques Cohen, et al, Human Reproduction, (12) 1742-1749, 1997, measured VOCs in compressed air and identified 18 VOCs totaling 552 µg/m³. This is relatively low, and confirmed verbally by Antonia Gillian, both for CO₂ and triple gas compressed cylinders. According to Kathryn Worriow, Ph.D., who has studied IVF air quality extensively, the average total VOCs in IVF labs is approximately 3,000 µg/m³.

A study was designed to evaluate the capacity and efficiency of the UltraPure® filter which was performed by an independent, third party testing laboratory, Southwest Research Institute. The study was performed under GLP and completed in December, 2012.

Study Design

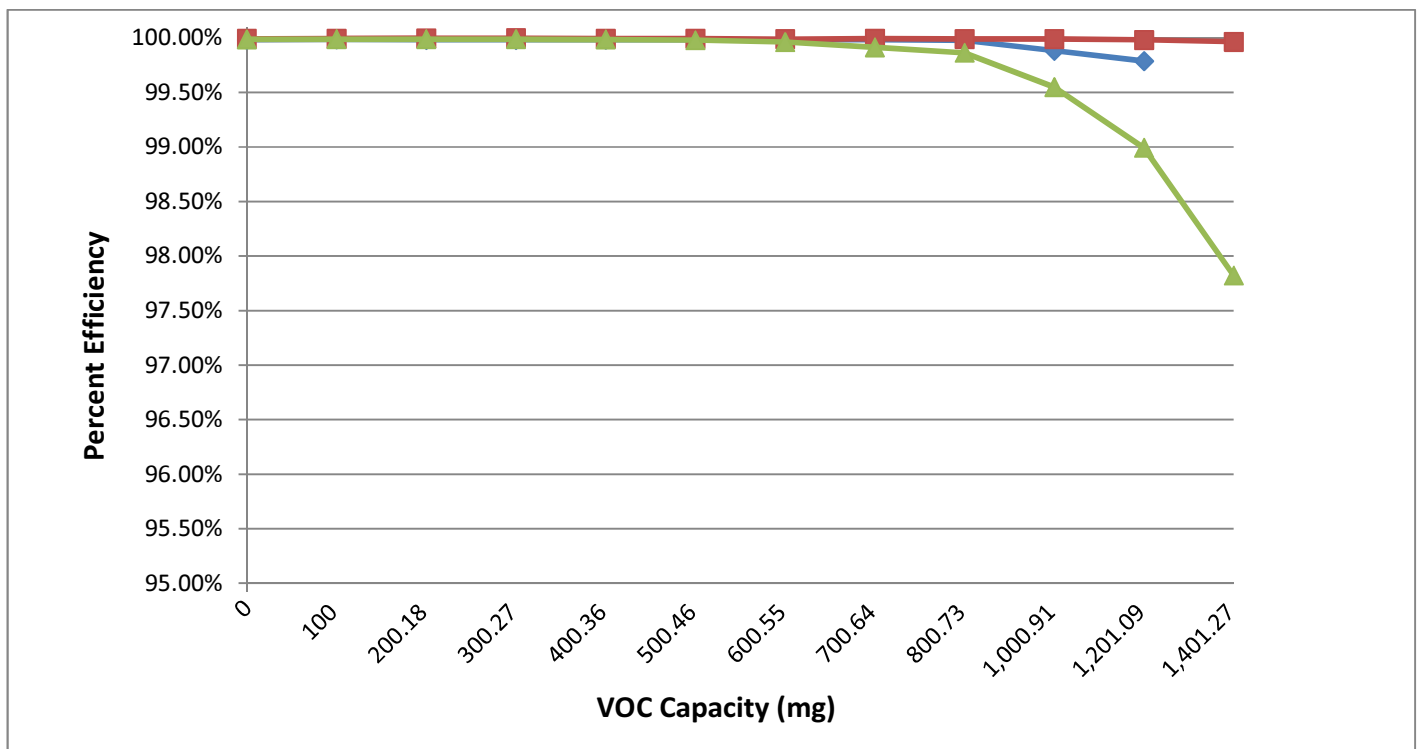
A custom cocktail of VOCs typically found in IVF laboratories was made based on the following chart from Dr. Worriow:

Volatile Organic Compounds – <i>In Vitro</i> Fertilization	Included in Cocktail
Isopropyl Alcohol	√
Ethanol	√
Methanol	√
Acetone	√
Toluene	√
Xylenes	√
2-Butanone	√
Styrene	√
Acrolein	√
Benzene	√
Ethyl Acetate	√
1,1,1-Trichloroethane	√
n-Decane	
n-Hexane	√
Methylene Chloride	√
Formaldehyde	
Acetaldehyde	
Propionaldehyde	√
Hexaldehyde	
Butyraldehyde	√
Benzaldehyde	
Hexanaldehyde	√
Nonanal	

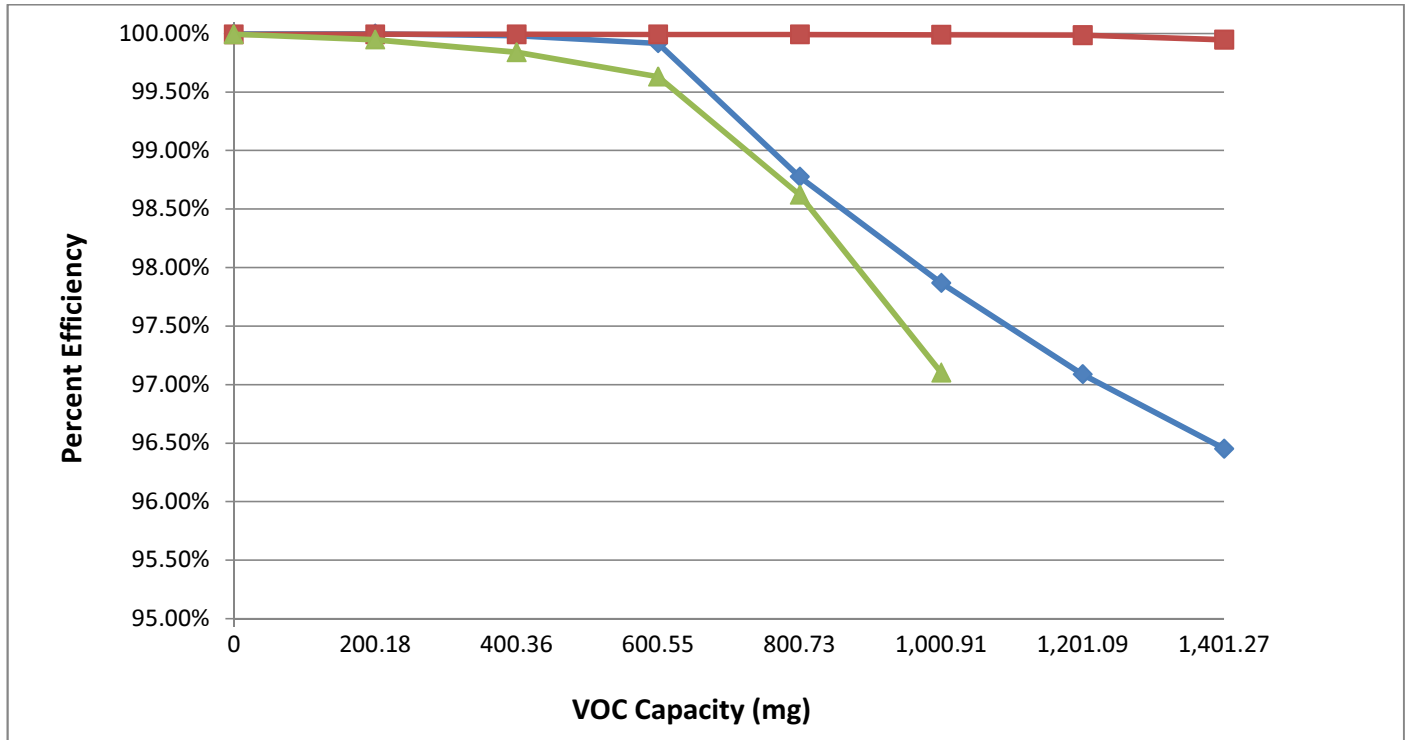
There were six compounds not included in the cocktail because of their instability in the mixture, but all families of compounds were represented. The gas cylinder contained equal concentrations of the compounds at approximately 100 parts per million by molar volume (ppmv). The gas was passed through the test filter at a flow rate of 0.36L/min comparable to the maximum flow rate in a mini – incubator, at 22-25 psi, and sampled periodically over 20 hours at the outlet. Three new filters and 3 *unused* filters that were at the end of their shelf life (3 years old) were tested. The efficiency of the filters is the percentage of VOCs captured and the capacity is the amount of retained VOCs. VOCs were analyzed using gas chromatography coupled to mass spectrometry.

Results

3 New UltraPure® Filters:



3 End of shelf life UltraPure® Filters (3 years old, *unused*):



Summary

UltraPure® filters were challenged with a typical mix of VOCs found in IVF laboratories. Using 3,000 µg/m³ as the average TVOCs in IVF labs, at a flow rate of 22L/hr, the required capacity is 289 mg over 6 months. The filters provide at least twice this capacity with over 99% efficiency. The combination of activated carbon and potassium permanganate provides excellent filtration to remove VOCs from the air supply for incubators in IVF clinics.