
Technical Report

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Subject: Purafil SP Media mercury adsorption efficacy

Scope

To evaluate Purafil SP Media removal efficiency against mercury vapor in the air.

The tests were conducted at Assay Technology Inc. Tests with mercury vapor challenge can provide an indication of the adsorption power of the PuraShield 500 equipped with SP Media for dental office mercury release control.

Background

Elemental mercury (Hg) is a large component (about 50%) of dental amalgam. In routine occupational tasks, including preparation, restoration, polishing, scaling, and removal of dental amalgam, elemental mercury vaporization from mercury amalgam results in short-term exposure of mercury vapor to dentist and dental workers that may exceed occupational safety limits.

Many studies have shown that dental workers on average have higher systemic levels of mercury in their tissues and organs than do members of control groups. Studies have specifically called for protective measures to be taken in the dental office to limit mercury releases.

Experimental Method

The Purafil SP sample (76g) is packed in a column (5cm diameter) with a 5cm bed depth. Then the challenge mercury vapor is introduced into the column at 5L/min at 25°C and 50% relative humidity. Mercury testing is done with elemental mercury vapor at 21 mg/m³, with a breakthrough of 0.05 mg/m³, as these are the concentrations stated on the NIOSH testing standard. The test was run over an 8hr period. The mercury downstream of the sorbent bed is monitored with a UV based mercury vapor analyzer that is specific for mercury vapor. Any oxidized mercury produced by Purafil SP media would remain on the filtration media.

Results and Discussion

Purafil SP Media has significant mercury adsorption power (Table 1). Within one second contact, SP media adsorbed all the upstream Hg delivered at 21mg/m³. After 8hr continuously challenge, SP media still captured all the Hg in the air and the downstream Hg breakthrough is below the NOISH standard 0.05mg/m³. It was noticed that only the top 1cm bed of media color changed from purple to dark grey. This indicates that mercury oxidation/adsorption mainly retained only within the top 1cm bed. The active ingredient NaMnO₄ provided oxidation of gaseous Hg⁰, which oxidized the elemental mercury into Hg²⁺. The oxidized mercury was remained on the porous pellets. If the top 1cm bed media was completely consumed, the Hg capacity of SP could be estimated as 3.3mg/g (0.3%wt).

Table 1 Purafil SP Media Mercury Vapor Service Life Test Results

SAMPLE NO	SAMPLE DESCRIPTION	GAS	CONC mg/M3	TEMP oC	REL HUM % RH	VOL FLOW RATE LPM	Column Size		LINEAR FLOW RATE CM/SEC	BED DEPTH CM	BED VOL CM ³	SORBENT MASS GM	SORBENT MASS END GM	BREAK THROUGH CONC mg/M3	BREAK THROUGH TIME MINUTES
							DIA CM	AREA CM ²							
20016694	Purafil SP Media	Mercury	21	25	50	5	5.0	19.6	4.2	5.0	98	76.0	74.7	0.05	>480

Purafil SP Media consists of generally spherical, porous pellets formed from a combination of activated alumina and other binders, suitably impregnated with 12%wt sodium permanganate (NaMnO₄). It has been specially engineered to provide the highest oxidation potential available thus assuring the highest overall performance. Purafil SP Media demonstrates a high working capacity for mercury release control.

Purafil has conducted multiple tests to evaluate the correlation between media oxidation potential and NaMnO₄ content. In general, the oxidation potential is positively correlated to the NaMnO₄ content. One study indicates that, when NaMnO₄ content increased from 8 to 12%wt, the chemical oxidation capacity could increase by 60%.

Summary

A 3rd party lab test indicates that Purafil SP Media has significantly high mercury (Hg) adsorption power (Table 2). SP media removed 99.8% Hg vapor from the air. Air Hg concentration dropped from 21mg/m³ to below the NOISH standard 0.05mg/m³. The reduction rate was constant during the whole 8hr testing.

The active ingredient NaMnO₄ in SP provides oxidation of gaseous Hg⁰ into oxidized Hg²⁺. The oxidized mercury is remained on the porous pellets.

Table 2 Purafil SP Media Mercury Removal Test Results

Sample	GAS	Removal, %
Purafil SP Media	Mercury (Hg ⁰)	99.8%

(Test conditions: size 5x5cm, SP weight 76g, Gas concentration: 21mg/m³, Flow rate 5L/min, Temperature 25°C, RH 50%)

Mercury vapor release to the atmosphere from mercury amalgam can be substantial and can exceed human exposure limits (Appendix A). dental offices need to take safety measurements by using air purifying and filtration system. The PuraShield 500 is designed to filter indoor air contaminants including mercury found in dental offices.

PuraShield 500 is equipped with multi-layered protection combines patented filter technologies against mercury, formaldehyde, odors, and airborne bacteria and viruses. It has a patented multi-stage filter cartridge with 22lb (10kg) of Purafil SP Media.

Example

For a dental room size 300sqft with 10ft ceiling, if one in-situ amalgam incident releases Hg to the air to 0.5mg/ m³ Hg, within 5min, the PuraShield 500 can decrease the Hg concentration from 21mg/m³ to below the 0.05mg/m³ NOISH standard. The SP media will allow the unit to handle 700 similar incidents. Or, if once per day, the unit will purify the Hg in the air for two years.

References

<https://pubmed.ncbi.nlm.nih.gov/16678246/>

<https://occup-med.biomedcentral.com/articles/10.1186/1745-6673-8-27>

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2013 Warwick, et al. *Journal of Occupational Medicine and Toxicology* 8:27

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Appendix A:

From: [Mercury vapour exposure during dental student training in amalgam removal](#)

	Suction and water spray	Suction only (no water spray)	No suction and no water spray
Arithmetic mean and standard deviation (µg/m ³)	8.0 ± 3.7	142.0 ± 234.6	214 ± 226.4
Median (µg/m ³)	8.0	68.0 ¹	117.0 ²
Range (µg/m ³)	4.0–19.0	14.0–999.0	34.0–796.0

¹ Statistically significantly greater (p < 0.001) from Suction & Water.

² Statistically significantly greater (p = 0.031) from Suction & Water.