DD2009 Chairside Amalgam Separator

Instruction Manual
Version 1.01

Introduction – Mercury Contamination of Dental-Unit Wastewater

The Mercury (Hg) content of dental-unit wastewater has become increasingly important to the dental profession and regulations limiting its release into the environment are becoming more pervasive. Hg is a toxic element that persists in the environment and bioaccumulates in the food chain. It remains among the top twenty hazardous substances listed on the Agency for Toxic Substances and Disease Registry (ATSDR)/ United States Environmental Protection Agency (USEPA) priority list.

Hg release from dental offices has become an acute issue for the dental profession and has resulted in efforts by regulators to mandate both the use of Best Management Practices (BMPs) as well as the installation of amalgam separators (devices that remove mercury containing amalgam from dental wastewater). Data from Publicly Owned Treatment Works (POTWs) serving areas with installed bases of separators in dental offices suggest these devices can substantially reduce Hg burdens to wastewater treatment plants (WWTPs).

Wastewater produced in the dental office is a heterogeneous mixture of nearly all the materials used by dentists and their staffs together with tissue, blood, saliva, and microorganisms. Hg in dental-unit wastewater ranges from large sized amalgam particles, submicron Hg-containing colloidal particulates and dissolved Hg species.

Particle size distribution experiments have shown that 90% of the Hg is located in particles larger than 10 microns. 97.3% of the Hg in settled wastewater samples taken directly from the dental chair is in the form of elemental Hg (Hg^0) bound to particulate. Hg is also present in the following forms: ionic Hg (Hg^{+2}), dissolved elemental Hg (Hg^0) and monomethyl Hg (MeHg). Mean concentrations from settled wastewater taken directly at the chair are: Total Hg 21.438 mg/liter (ppm), MeHg 277.74 ng/liter (ppt), Hg^0 24.06 μg/liter (ppb), Hg^{+2} 54.00 μg/liter (ppb) and Hg^0 bound to amalgam particulate 21.360 mg/liter (ppm).

The average daily Hg loading to dental-unit wastewater is exceedingly variable and in one study was seen to average 0.484 grams per chair per day (n=25, SD=0.420). Hg loadings from a dental chair in a second study were seen to average over 2 grams of Hg per day. The high density of amalgam (the specific gravity of dental amalgam is 11.6) results in average settling velocities ranging from 16.56 to 65.7 cm/hour, with over 90% of amalgam particulate settling in 2 hours.

A consequence of this rapid settling is the deposition of amalgam particulate in the wastewater lines leaving the dental chair. Determination of residual Hg levels in dental vacuum lines demonstrated Hg levels averaging 29.6 grams/kg of pipe (range=0.710 grams/kg to 177 grams/kg, SD=55.4).

Toxicity Characteristic Leaching Procedure analysis (defined in USEPA Method 1311 and used to help determine if a waste is hazardous) demonstrated substantial levels of Hg leaching out of the lines. Hg levels in the leachate from one sample were high enough to meet the criteria of hazardous waste and suggest that dental wastewater lines might serve as a reservoir of Hg that can leach over time.

Oxidizing line cleaners used in some offices to disinfect wastewater lines can mobilize Hg from amalgam particulate and this may also be true for the Hg in amalgam sludge present in wastewater lines.

Installation:

Installation of the chairside amalgam separator varies as a function of dental chair design. Photographs of a typical installations are shown below and may be useful as guides. The separator is placed under the dental chair and spliced inline the high volume evacuation lines (5/8 inch).

The separator has two 5/8 inch NPT ports: one is the “inlet” port and is located “off axis”. The second port is the discharge and is located in the center axis of the separator. It is important to have the “inlet” port connected to the HVE tip (i.e. coming from the patient) and the “outlet” port connected to the vacuum source.

In many dental chairs, the vacuum hose is snaked inside the chair and subject to sharp bends which limit the air flow through the hose. A short direct connection from the floor to the separator improves vacuum levels and prevents debris from occluding the hose.

It is recommend that the chairside trap remain in use. The trap prevents large pieces of debris from clogging hoses. In some cases the chairside trap can be removed. By bypassing the chairside trap, all debris will be collected by the amalgam separator.

We recommends the use of the Dental EZ Flowcheck™ vacuum gauge to measure chairside vacuum levels before and after installation of the filtration unit. The Flowcheck™ dental vacuum flow measurement device is available from Dental EZ corporation (http://www.dentalez.com/ramvac/accessories/flowcheck.html).

Dental EZ Flowcheck dental vacuum measurement device. Used to measure air flow (quality of dental vacuum) at the HVE tip. More information can be obtained at http://www.dentalez.com/ramvac/accessories/flowcheck.html

The Dental EZ Flowcheck™ provides a good way to check to see if HVE vacuum performance at the chairside is being met. Using the Flowcheck™ lookup chart, 7 scfm of air flow at the HVE tip would translate into approximately 1.5 inches of Hg at sea level.

There is a draft ISO standard for dental vacuum systems, ISO/PDTS 22595-1. The draft ISO standard calls for an air flow of at least 250 liters/minute (4.1 liters/second) at the HVE tip.Testing of the DD209 chairside amalgam separator has demonstrated minimal impact on suction quality. Air flow measurements with the Dental EZ Flowcheck™ on a dental unit with a chairside filter has measured air flows of 4.4 liters per second.

The Department of Defense Medical Military Facilities Design and Construction Criteria (Military Handbook-1191) calls for the following dental vacuum system operating criteria to be met:

- 21 to 27 kPa (6 to 8 in-Hg) with a minimum vacuum of 21 kPa (6 in-Hg) to be maintained at the farthest HVE inlet

- A flow rate of 3.3 liters/second (7 standard cubic feet per minute).

The DD2009 amalgam separator shown installed on a Dental EZ chair. The unit is placed on the floor next to the chair. It can be located inside the floor mounted junction box if space permits. The unit shown here is place to the side of the chair but can be move to any location that is convenient.

The photograph at the left shows the inflow side of the DD2009. Note that the inflow port is “off axis”. This side of the separator is connected to the HVE line coming from the patient. Note the red vinyl cover over the 5/8 inch inflow port of the separator. When the separator is loaded with debris and needs changing, the red vinyl cover is placed over the port to prevent any leakage of debris from the separator.

The photograph at the left shows the outflow side of the DD2009. Note that the outflow port is in line with the long axis of the separator. This side of the separator is connected to the vacuum source. Note the red vinyl cover over the 5/8 inch outflow port of the separator. When the separator is loaded with debris and needs changing, the red vinyl cover is placed over the port to prevent any leakage of debris from the separator.

Amalgam Waste Recycling Issues

Although mercury in the form of dental amalgam is very stable, amalgam should ***not*** be disposed of in the garbage, infectious waste "red bag," or sharps container. Mercury containing amalgam waste generated in the dental operatory can on occasion meet the requirement of a hazardous waste. Amalgam also should ***not*** be rinsed down the drain. Some communities incinerate municipal garbage, medical waste, and sludge from wastewater treatment plants. If amalgam waste ends up being incinerated mercury vapor can be released to the environment due to the high temperatures used in the incineration process. Increasingly, local communities are enacting restrictions on the incineration of wastes containing mercury.

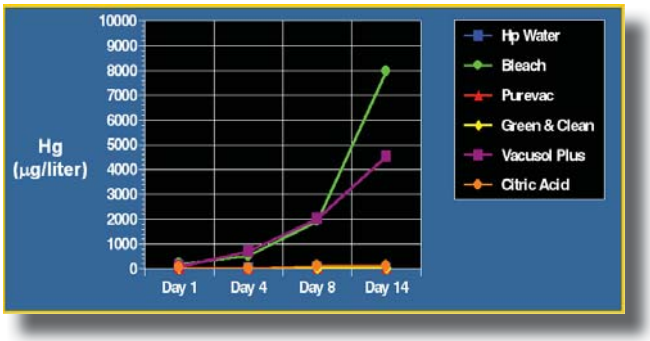
Contact you local environmental specialist prior to disposal of any mercury containing hazardous waste.

ISO 11143 Certification

The disposable chairside amalgam separation system has been tested and passed the ISO 11143 protocol.

Vacuum Line Cleaner Effects on Hg Levels

Vacuum line cleaners are recommended by some manufacturers of dental vacuum systems to help keep the lines from plugging and to limit the formation of odors from the breakdown of wastes remaining in the lines. Testing by NIDBR and others has shown that the chemical makeup of line cleaners can have important effects on dissolved Hg levels in dental wastewater. Oxidizing line cleaners, especially chlorine containing products like sodium hypochlorite (bleach) can mobilize or dissolve Hg contained in amalgam particles found in vacuum lines.



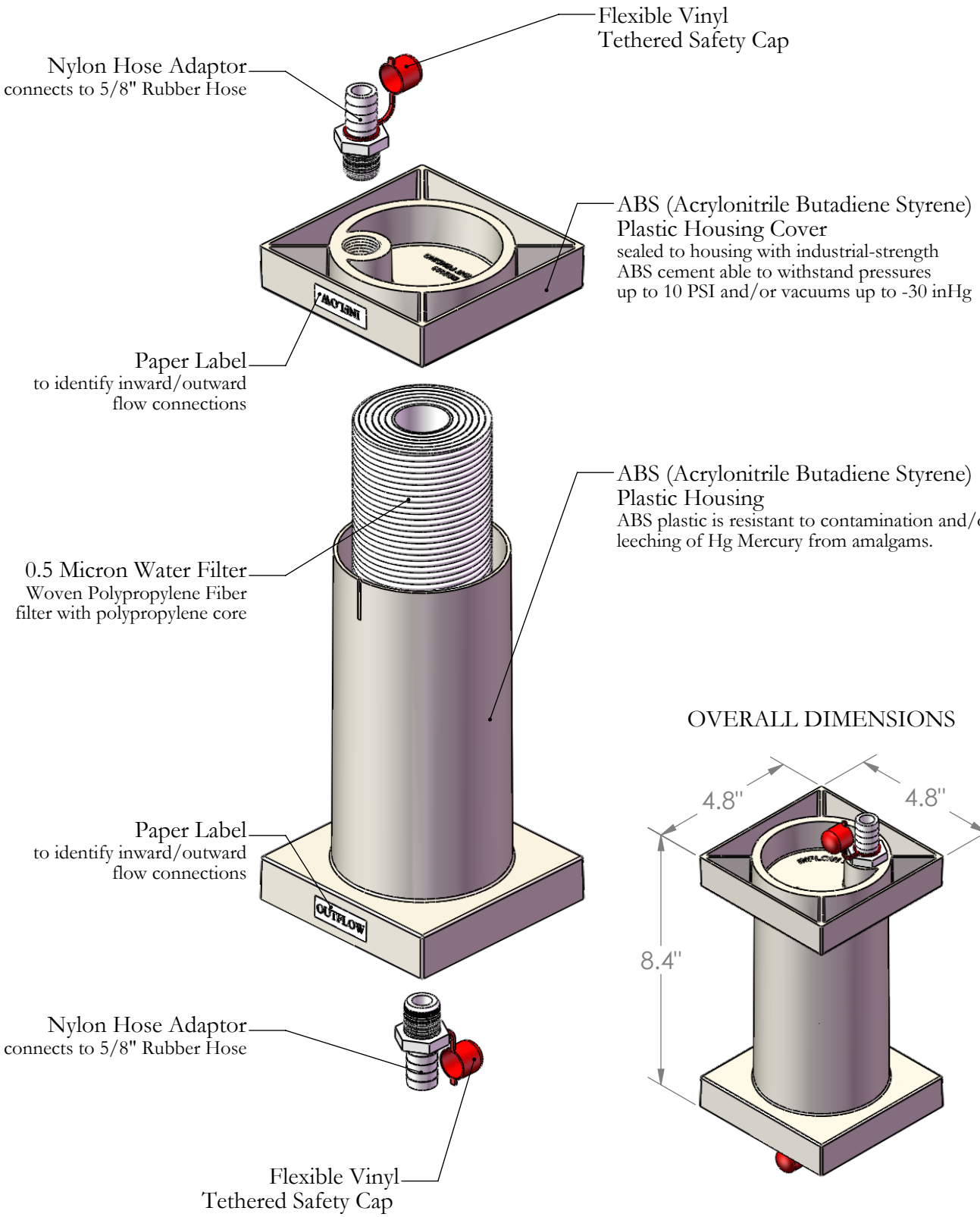
The graph above shows the effect line cleaners can have in mobilizing Hg from amalgam particulate to dissolved forms that are harder to remove and more bioavailable. Hp Water is deionized reagent water, Bleach is 0.16% sodium hypochlorite in tap water, Purvac, Green & Clean and Vacusol Plus are commercial vacuum line cleaner products. Citric Acid is sometimes used to rid dental-unit water lines of biofilm. Exposure to the line cleaners was from 1 to 14 days.

The following commercial line cleaners have been tested and are considered to not mobilize Hg from amalgam in appreciable amounts:

- E- Vac, L&R Manufacturing Co.
- Evacuation System Cleaner, Carlisle Labs
- Gobble Plus, Germiphene Corp.
- Green & Clean, Metasys
- Maxi-Evac, Henry Schein, Inc.
- OR-Evac, Henry Schein, Inc.
- ProE-Vac, Cottrel, Ltd.
- PUREVAC, Sultan Chemical Co.
- Sani-Treet Plus, Enzyme Industries
- Stay-Clean. Apollo Dental Products
- Turbo Vac Line Flush, Pinnacle, Inc.
- VacuCleanse, Infection Control Tech.
- Vac-U-EZ, DentalEZ, Inc.

Hg AMALGAM SEPARATOR (DD2009)

COMPONENT SPECIFICATION SHEET



DATED 7/27/09

Instructions for Changing Out Chairside Filters

The chairside filter/amalgam separator will need to be changed when vacuum levels fall below recommend values (see the manual for additional details). The used filter (still connected to vacuum lines) should be placed in a tray that will collect any spilled wastewater, preventing it from contacting the operatory floor. The photograph above shows a chairside filter placed in such a tray. Note that the vacuum lines are still connected to the filter: The inflow side of the filter is connected to the HVE tip and the outflow side is connected to the vacuum pump.

The inflow side of the filter is angled up at approximately 45 degrees and the vacuum hose is pulled off the inflow side hose barb. The end of the vacuum lines should be kept in the tray to trap any wastewater that may remain in the lines. Any wastewater that collects in the tray should be disposed of appropriately. ***DO NOT*** pour any of the wastewater down the drain since it may contain substantial amounts of mercury. The red vinyl cap is then placed over the inflow hose barb which seals this side of the filter.

The red vinyl cap has been placed on the hose barb to keep any wastewater from leaking out of the filter.

The filter is now inverted so that the outflow side is up. The outflow vacuum hose is separated from the filter and the red vinyl cap is placed securely over the outflow hose barb.

Photograph showing the used filter disconnected from the vacuum lines. The red vinyl caps are securely placed on both ends and the used filter is ready for recycling.