

## Disposal of Extracted Teeth with Amalgam Restorations (Fillings)

**1. PURPOSE.** This information paper provides guidance for disposal of extracted teeth with amalgam restorations (commonly referred to as fillings). It is intended to discuss the U.S. Army Public Health Center (APHC) multi-year environmental sampling study of extracted teeth with amalgam fillings and present disposal guidance based on the results.

**2. APPLICABILITY.** This information applies to teeth with amalgam fillings extracted during dental procedures on Army installations. Dental clinics are subject to state environmental regulations and should adhere to any more stringent requirements in their state or local area.

**3. BACKGROUND.** Dental amalgam is used in restorative work for filling teeth as the result of tooth decay. Amalgam is an alloy that contains silver, tin, copper, other metallic elements, as well as mercury, which typically makes up about 50% of the amalgam. Due to the mercury content, waste dental amalgam often exhibits characteristics of hazardous waste (HW) under the Resource Conservation and Recovery Act (RCRA). Mercury is a bio-accumulator that builds up in the environment and our food. Preventing mercury releases to the environment is the common goal in dental waste management. Extracted teeth have historically been managed as regulated medical waste (RMW) according to state and Army regulations. Fourteen years ago the Army RMW disposal contractor raised concerns about treatment of extracted teeth with amalgam fillings and suggested the teeth were HW according to RCRA. However, the contractor was unable to provide any data proving that extracted teeth with amalgam fillings are HW due to mercury content. The APHC [formerly the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM)] researched policy statements, publications, regulations, and fact sheets from the Centers for Disease Control and Prevention (CDC), American Dental Association (ADA®), and the U.S. Environmental Protection Agency (EPA) to determine if an HW characterization of extracted teeth with amalgam fillings had been conducted. The APHC determined that, while the three Agencies set goals for total mercury reduction in the environment, the Agencies provided no literature or data to support the conclusion that extracted teeth with fillings are HW according to RCRA HW regulations. In response, the APHC initiated a multi-year environmental sampling study of extracted teeth with amalgam fillings to evaluate their mercury content according to RCRA limits.

**4. REFERENCES.** See Appendix A for complete reference information.

### **5. ENVIRONMENTAL TESTING.**

**Representative Samples.** Samples of extracted teeth with amalgam fillings differ from samples of scrap amalgam because the samples include both the tooth mass and the filling. Also, the fillings tended to be intact amalgam alloys imbedded in the teeth instead of exposed, rough-edged, shards of scrap amalgam. Twelve samples of extracted human teeth were collected and submitted for environmental analyses from 2004 to 2018. Each sample submitted consisted of 75–100 extracted human teeth with intact amalgam fillings. The extracted teeth with fillings included variable types and ages of teeth and variable types and ages of amalgam used for the fillings. Sample collection was conducted voluntarily by Army dental clinics on installations across the County. Sample accumulation

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was slow because most teeth are repaired instead of extracted, and collection was voluntary. All teeth samples were submitted for analyses using the Toxicity Characteristic Leaching Procedure (TCLP) for mercury content according to RCRA requirements in Title 40 Code of Federal Regulations (CFR) Section 261.24(b). The teeth were wiped clean of blood and debris; they were then sprayed with nonchlorine containing hospital-approved disinfectant and allowed to air dry to avoid leaching mercury into the disinfectant solution. The extracted teeth were collected and submitted dry for the analyses. The samples were only evaluated for mercury content because a previous USACHPPM amalgam study indicated no other EPA regulated metals were of concern for waste amalgam.

**Analytical Results.** The analytical results are provided in Table 1. All results were compared to the RCRA TCLP limit of 0.2 milligrams per liter (mg/L) of mercury. None of the sample results exceeded the 0.2 mg/L mercury limit necessary for HW management.

**Table 1. Analytical Results**

<b>Sample Number</b>	<b>Date Analyzed</b>	<b>Result</b>
DENCOM-4	27 Apr 2018	0.0051 mg/L
DENCOM-3	27 Apr 2018	0.0045 mg/L
DENCOM-2	17 Jun 2016	0.044 mg/L
DENCOM-1	17 Jun 2016	0.015 mg/L
3EAMC	15 July 2011	0.015 mg/L
2EAMC	15 July 2011	0.011 mg/L
1EAMC	15 July 2011	0.012 mg/L
201100539-03	21 Feb 2011	0.0095 mg/L
201100539-02	21 Feb 2011	0.0082 mg/L
201100539-01	21 Feb 2011	0.027 mg/L
Camp02	27 Feb 2008	< 0.020 mg/L
Camp01	14 Sep 2004	0.024 mg/L

**Waste Characterization.** The resulting conclusion from the environmental sample results is that an extracted tooth containing an amalgam filling does not leach mercury above the accepted regulatory level of 0.2 mg/L, resulting in a nonhazardous waste characterization. Wastes that meet the nonhazardous characterization criteria are classified as solid wastes.

**6. REGULATORY CONSIDERATIONS.**

**Occupational Safety and Health Administration (OSHA).** Discarded extracted teeth are subject to the OSHA Bloodborne Pathogens Standard (BBPS) while being handled in the dental clinic. OSHA considers extracted teeth to be potentially infectious material that should be disposed of in medical waste containers if not returned to patients or used for laboratory research. According to OSHA, dental

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clinics may return extracted teeth to patients upon request. Once an extracted tooth is returned to a patient, it is no longer considered a potential risk to dental healthcare personnel and is no longer subject to the provisions of the OSHA BBPS. Though OSHA recommends RMW disposal of extracted teeth, OSHA regulatory authority only applies to hazardous material management in the workplace, not waste management. Applicable waste management requirements are enforced by the EPA and state environmental authorities.

**U.S. Environmental Protection Agency.** The analytical test results discussed in paragraph 5 were conducted according to EPA requirements in Title 40 CFR, Parts 262.11 and 262.24(b). The results indicate that extracted teeth with fillings do not require HW management according to Federal EPA regulations and can be managed as solid waste or RMW depending on applicable state regulations. The EPA regulates scrap metals sent for recycling. Though the test results were nonhazardous, extracted teeth with amalgam fillings are eligible for voluntary scrap metal recycling according to EPA regulations. Extracted teeth with amalgam fillings can be combined with scrap amalgam collected from the trap filters and sent off for mercury recycling according to EPA guidance. The EPA does not regulate the disposal of RMW, and, therefore, does not provide an RMW definition. Instead each state is responsible for establishing RMW disposal requirements (see State Regulations).

**State Regulations.** Note, RMW is a specially regulated type of solid waste, not a HW. Generally, state RMW regulations incorporate the OSHA BBPS regulated waste definition, or a variation of it, into state-specific RMW definitions and classifications of biologically contaminated wastes. A few states include extracted teeth in the RMW definitions, thus, requiring RMW treatment of untreated, extracted human teeth upon disposal. Returning teeth to patients or continued use in research would not constitute disposal and would not violate state RMW disposal regulations. Other states regulate dental amalgam waste as special state HW or special solid waste requiring amalgam to be recycled for its mercury content. If such a regulation exists, it would supersede the RMW disposal requirement and the EPA nonhazardous characterization because states may voluntarily impose more stringent environmental regulations than Federal regulations. If the state does not specify that teeth are RMW or a special HW/recycling waste, then the nonhazardous EPA (Federal) waste characterization in paragraph 5 will apply.

## 7. MERCURY TOXICITY AND ENVIRONMENTAL RELEASES.

**Chemical Forms.** Mercury exists in three major chemical forms: elemental mercury, inorganic compounds, and organic compounds. Each chemical form exhibits unique physical and chemical properties, which are absorbed and excreted differently in the human body, resulting in unique human toxicological profiles. Elemental or metallic mercury is a liquid at room temperature and is used in dental amalgam, florescent lamps, electrical switches, and other industrial processes. Mercury vapor in the air is a volatile example of elemental mercury that occurs when items containing elemental mercury are exposed to extreme heat and/or pressure. Organic mercury compounds form when mercury combines with carbon. Microscopic organisms in the environment can convert elemental and inorganic mercury into the organic mercury compound, methylmercury, which is most commonly ingested through consumption of seafood. Inorganic mercury compounds, or salts, form when mercury combines with elements such as oxygen or sulfur either naturally in the environment or during industrial processes. Inorganic mercury compounds are most commonly used in the making of other industrial chemicals. People may be exposed to inorganic mercury compounds through work place exposures or use of some antiseptic creams and ointments.

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**Mercury Releases from Extracted Teeth with Fillings.** An amalgam filling is a very stable, inorganic mercury alloy. The TCLP results verify its stability and lack of mercury leaching into the environment when exposed to strong, acidic solutions. The testing proved the extracted teeth with amalgam fillings pose very little threat to the environment in dry conditions at room temperature. Conversely, studies have proven that exposing amalgam fillings to heat through incineration will release some elemental mercury vapor into the environment. Industrial waste incinerators have equipment to remove mercury vapors; however, it is the preferred best management practice of the ADA, CDC, and EPA to avoid incinerating all forms of mercury waste if possible. A 1996 study entitled Mercury Release during Autoclave Sterilization of Amalgam (Parsell, et al 1996) concluded that autoclave sterilization does convert small amounts of the inorganic amalgam alloy into elemental mercury vapor that is released upon opening the sterilizer door. This study is often cited as a reason to prohibit steam autoclaving of extracted teeth with amalgam fillings. It is important to note that the study simulated sterilizing 175 teeth with amalgam fillings per autoclave bag. While the U.S. Army Dental Corps does not track exact numbers of extracted teeth with amalgam fillings versus extracted teeth with composite (a.k.a. white) fillings, the U.S. Army Dental Corps averages 410 tooth extractions per day across approximately 134 Army Dental Treatment Facilities (DTFs). Forty-six percent of all dental restorations placed in DTFs are amalgam fillings, which is an average of 1 amalgam filling per day in each DTF. Given the minimal number of extracted teeth with fillings at each clinic, an Army DTF would not accumulate the volume simulated in the experiment within the time an RMW or solid waste container was removed for treatment and disposal. Therefore, the disposal of one or two teeth per waste container would not pose a significant mercury vapor release when sent to an RMW autoclave or incineration facility.

**Sterilization of Teeth in Educational Settings.** The Office of the Surgeon General/U.S. Army Medical Command (OTSG/MEDCOM) Policy Memo 19-032 provides a sterilization process for teeth with amalgam fillings that will be used for research and are not destined for disposal. The process calls for immersion in 10% formalin for 2 weeks. Formalin can leach mercury out of the fillings, creating a potential HW. Once the teeth are removed from the formalin, the waste formalin must be evaluated for mercury content via a TCLP analysis. A result less than or equal to 0.2 mg/L is not an HW. Any result exceeding 0.2 mg/L will require HW management and disposal.

**Disposal.** Disposal in a landfill or via incineration is permissible for nonhazardous waste. Recycling as a scrap metal or universal waste for mercury content is also permissible. State regulations will dictate which disposal method is required. Dental clinics in most states will have the option and/or requirement to recycle extracted teeth with amalgam fillings along with the scrap amalgam (see Recycling). In states that specifically require disposal as RMW, manage the extracted teeth with fillings in the same manner as extracted teeth without fillings. Do not accumulate a container of extracted teeth with fillings as a separate waste stream. Less teeth with amalgam fillings in the RMW container will reduce the potential for mercury vapor releases during treatment (not a requirement but a best management practice).

If your state requires HW disposal for amalgam wastes, the Defense Logistics Agency (DLA) Disposition Services regulations allow generators to add extracted teeth with amalgam fillings to the scrap amalgam waste container. The DLA Disposition Services has stipulated that the teeth must be certified noninfectious by the dental clinic's medical authority. This certification is a memorandum signed by someone stating that the teeth were disinfected according to established procedures (see Disinfection). [Note, amalgam wastes turned in to the DLA Disposition Services will go out as HW

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instead of recyclable scrap metal unless a current nonhazardous TCLP test result is presented with the waste.] The DLA-selected waste contractor may in fact recycle the mercury once it arrives at the treatment facility; however, it will be collected and managed as an HW on the installation.

**8. RECYCLING.** Amalgam waste can be safely and legally recycled, which is the preferred method of waste management for extracted teeth with amalgam fillings. In fact, several states now require dental amalgam in all forms, including intact restorations and scrap, to be recycled specifically for the mercury content. During recycling, a retort process removes the mercury from the amalgam waste, allowing it to be reused in new products. Other metals in the alloy, to include silver, are also extracted and recovered for reuse. Many commercial recycling contractors can be utilized to avoid unnecessary HW management and disposal of this waste stream. The APHC Environmental Health Sciences Division has vetted two mercury retort facilities that retort mercury waste and sell the reclaimed mercury back to the industry. For more information on the retort facility visits, please contact APHC.

If recycling is required by a state regulation or selected in lieu of HW management, the clinic must receive documentation of some kind to demonstrate that the mercury is actually recycled. All clinics should receive documented proof of recycling as a best management practice, even when not required by regulation.

Always check your state environmental regulations for any additional requirements that must be provided by the recycling company. You should also consult with your installation environmental office with regard to how your mercury waste should be sent to the recycling company (i.e., on a waste manifest or shipping document). Select a reputable recycling company that complies with all applicable Federal and state laws. The ADA recommends choosing a recycler that complies with American National Standards Institute (NSI)/ADA Specification 109: Procedures for Storing Dental Amalgam Waste and Requirements for Amalgam Waste Storage/Shipment Containers. Consider the following factors:

- Is the company legitimately recycling the mercury (i.e., is it reclaiming the mercury and selling it back to industry) or is it sending it to another facility for destruction?
- Will the company provide you with proof that your mercury waste was recycled?
- Does the company have an applicable state or EPA operating license?
- Will the company accept extracted teeth with amalgam fillings comingled with scrap contact amalgam?
- Does the company provide waste collection and shipping containers?

**9. WASTE MANAGEMENT IN THE CLINIC.** The disposal option chosen will determine the collection and label procedures implemented. Extracted teeth with amalgam fillings and scrap amalgam collected for HW or recycling must be collected dry, in well-constructed containers with secure lids. (Dry is defined as not soaking in any solution while the waste is accumulating in the clinic.) If recycling the waste, mark the containers to indicate the waste is destined for recycling. If disposing the waste as HW, mark the containers with the words “hazardous waste” and words or symbols that convey the hazards of mercury, such as the Department of Transportation toxicity label, OSHA toxicity pictogram, or the words “toxic—contains mercury, D009.” The HW collection container used for amalgam waste must remain closed except when adding or removing waste. The area where amalgam waste is collected for HW disposal must be managed according to the satellite accumulation area (SAA) HW regulations. The

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dental clinic may operate a SAA that serves as a centralized location within the operatory wing/clinic where staff can come to disinfect the amalgam generated in each dental operatory, and then place it in the collection container. The SAA may be placed in a soiled utility room or workbench area or in each individual operatory. Consult your Preventive Medicine Environmental Science and Engineering Officer and/or your installation environmental office for placement of the SAA, waste collection guidance, and turn-in requirements.

**10. DISINFECTION.** Clinic personnel must disinfect the exterior surface of the tooth so that it is no longer considered RMW in order to meet the requirements for management as an HW or recycled waste. Disinfection in this setting is to limit the transmission of bloodborne pathogens when handling the exterior of the extracted tooth. According to the OSHA BBPS, any waste that does not have free flowing liquids or caked/dried blood in quantities capable of sustaining a bloodborne pathogen is not infectious. Because the ADA, CDC, and EPA all recommend not autoclaving teeth with extracted fillings to avoid any potential releases of mercury vapor (see Mercury Toxicity and Environmental Releases), disinfection will be accomplished through manual surface cleaning and application of liquid disinfectants.

According to the CDC, "Cleaning is the necessary first step of any disinfection process. Cleaning removes organic matter, salts, and visible soils, all of which interfere with microbial inactivation. The physical action of scrubbing with detergents and surfactants and rinsing with water removes substantial numbers of microorganisms."

- Employ manual procedures and/or ultrasonic cleaning devices approved by your dental clinic infection control officer to clean off visible blood and gross debris from the extracted tooth.
- Next, allow the tooth to dry
- Then, apply a nonchlorine, nonoxidizing disinfectant approved for use in dental clinics.
- Use of a nonchlorine-containing disinfectant will minimize the potential for mercury to leach into the disinfectant.
- Follow the manufacturer's guidelines for contact time with the liquid disinfectant.
- After achieving the required contact time, allow the tooth to dry.

**11. ORDER OF CONSIDERATION.** Clinic personnel must consider regulatory considerations in this order:

- Is it a state regulated HW? If so, disinfect and manage as HW.
- Does the state mandate recycling for amalgam wastes? If yes, disinfect and recycle for mercury content.
- Does the state regulate as RMW? If yes, manage as RMW.
- If no state regulations apply, consider voluntary recycling with the scrap amalgam.
- If no state regulations apply and recycling is not available, dispose as solid waste.

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## APPENDIX A

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