Dental Amalgam Use

A Pollution Prevention Perspective

In Brief

This factsheet presents an estimate of the amounts of amalgam restorative materials that are involved with a single, average-sized placement or removal procedure.

These estimates are based upon: (1) interviews with dental professionals; (2) surveys of dental office amalgam use in the San Francisco area during 2004; and (3) dental amalgam MSDSs.

Amalgam Handled for One Placement Procedure

The amount of amalgam involved with each placement procedure depends upon several factors, including the:

- size of individual restorations (often referred to in terms of the tooth surfaces involved);
- size and design of amalgam capsule selected for trituration; and
- amount of carving that is necessary to remove excess amalgam that has been placed in the patient's tooth.

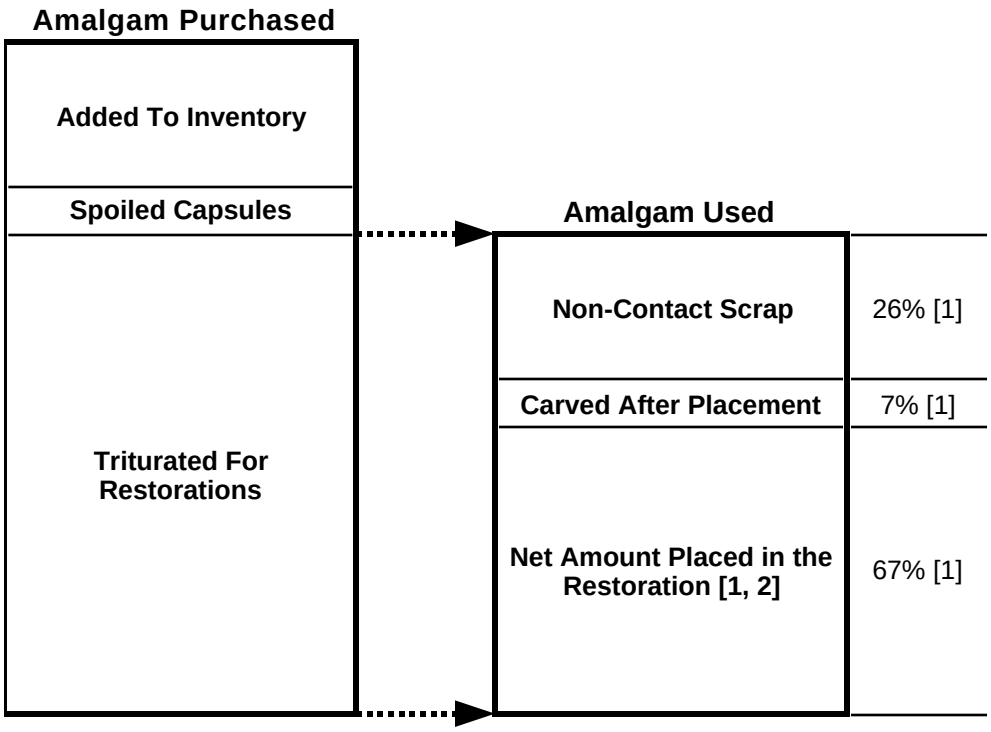
Exhibit 1 illustrates these factors, and highlights the key point that the amalgam purchased in a year is typically more than the amount used in restorations. The number of spoiled capsules is not known, but is believed to be small.

Some practices report that their amalgam purchases and inventories are both declining as they shift toward using more composites and other restorative materials.

Exhibit 2 (on the next page) shows that the estimated amount of waste amalgam is equal to 0.45 grams per procedure, which is the sum of non-contact scrap and the excess that a dentist carves from a patient's tooth in order to complete the restoration.

Interviews of San Francisco Bay Area dentists indicate that on average about two-thirds of triturated amalgam ends up in the patient's teeth as a completed restoration.

Exhibit 1
Amalgam Purchases Versus Amounts Used



[1] Palo Alto RWQCP (Barron 2002)

[2] RCDSO, Toronto (Watson 2002b)

Exhibit 2
Amalgam Amounts - Placements

Amalgam Weight Per Placement (g)		
Non-Contact Scrap	0.35	26%
Carved After Placement	0.10	7%
Net Placed Amount	0.89	67%
Triturated Amount	1.34	
Waste Generated	0.45	

Amalgam Handled in One Removal Procedure

Exhibit 3 shows that the estimated average amount of amalgam waste generated by removal of old restorations is 0.85 gram per procedure. This estimate is based upon dentist interviews.

Exhibit 3
Amalgam Amounts - Removals

Amalgam Weight Per Removal (g)	
Weight Per Day	1.02
Number Per Day	1.20
Weight Per Removal	0.85
Waste Generated	0.85

Watson and Adegbembo conducted an extensive study of amalgam restorations performed by 690 dentists in Ontario (Watson, 2002b). This research indicates average sizes of amalgam placements and removals that are similar to those listed in Exhibits 2 and 3.

Net Sewer Discharge Per Procedure

Exhibit 4 summarizes the amalgam restoration sizes and weights that are used as the basis of the subsequent estimate. This waste estimate assumes that amalgam contains 45% mercury, which is the average of amounts reported in MSDSs for several commonly used capsules.

Exhibit 4
Amalgam and Mercury Amounts Per Procedure

	Average Amalgam Restoration Size			Waste Generated	
	Surfaces	Spills	Weight (g)	Amalgam (g)	Hg (g)
One Placement	2±	2.35	1.34	0.45	0.20
One Removal	2±	• • •	0.88	0.88	0.40

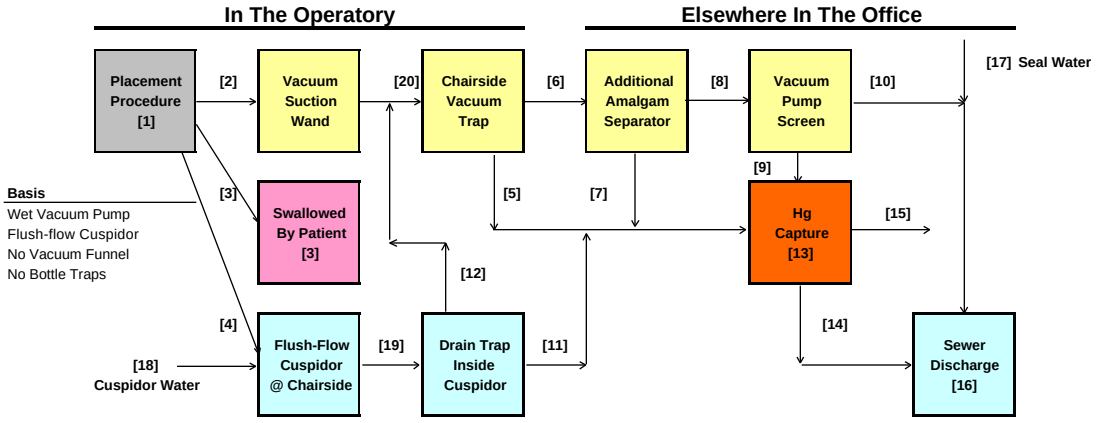
Exhibits 5 and 6 (see following pages) are hypothetical diagrams that show alternative pathways by which amalgam waste and the mercury it contains might leave a dental office, including amounts that are:

- swallowed by the patient;
- captured in the cuspidor trap;
- captured in vacuum traps, screens, and filters; and
- discharged to the sewer from the vacuum system.

The relative amounts of amalgam/mercury waste entering the cuspidor and vacuum system vary according to the:

- type of work being done;
- sizes of amalgam particles being produced; and
- presence or absence of a dental assistant who applies the high-volume vacuum suction tip in the patient's mouth.

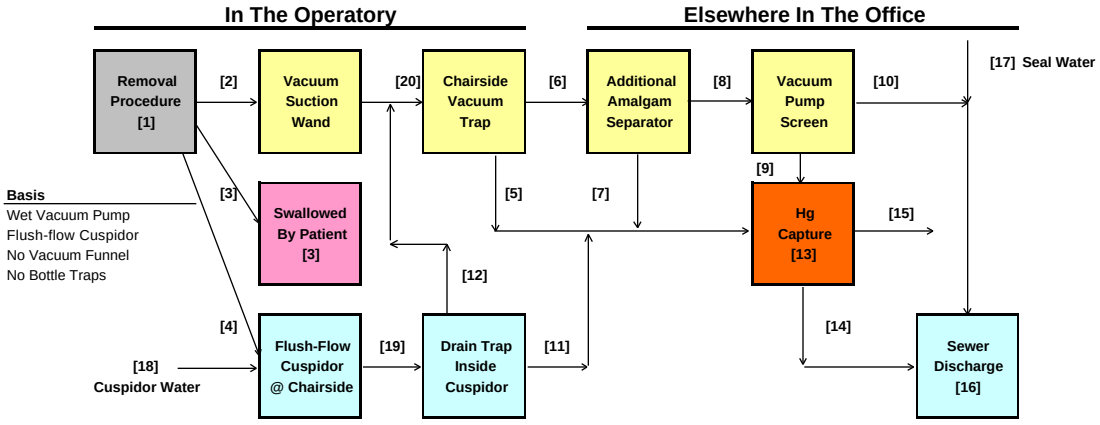
Exhibit 5
Example Hg Mass Balance - One Placement Procedure



Location	Flow (l)	A: Few BMPs		B: Some BMPs		C: All BMPs	
		Hg Mass (mg)	%	Hg Mass (mg)	%	Hg Mass (mg)	%
[1] One Amalgam Placement	1.0	190.0	100%	190	100%	190	100%
[2] Suction Wand	0.9	133.0	70%	133	70%	152	80%
[3] Swallowed by Patient	0.1	19.0	10%	19	10%	19	10%
[4] Mouthwash into Cuspidor	0.5	**38**	**20%**	**38**	**20%**	19	10%
[5] Vacuum Trap Capture	0.0	103	60%	96	60%	99	60%
[6] Pass Vacuum Trap	0.9	68	40%	64	40%	66	40%
[7] Amal. Separator Capture	0.0	0	0%	0	0%	**0**	**0%**
[8] Pass Amalgam Separator	0.9	34	100%	32	100%	33	100%
[9] Vacuum Screen Capture	0.0	34	50%	32	50%	33	50%
[10] Pass Vacuum Pump Screen	0.9	34	50%	32	50%	33	50%
[11] Cuspidor Trap Capture	0.0	0	0%	11	30%	6	30%
[12] Pass Cuspidor Trap	0.5	38	100%	27	70%	13	70%
[13] Total Capture	0.0	137	72%	139	73%	138	73%
[14] Release to Sinks	0.0	137	100%	**107**	**77%**	**6**	**4%**
[17] Vacuum Pump Seal Water	2.5	0	0%	**0**	**0%**	**0**	**0%**
[18] Cuspidor Water Flow	1.0	0	0%	0	0%	0	0%
[19] Cuspidor Wastes into Trap	1.5	38	100%	38	100%	19	100%
[20] Waste into Vacuum Trap	1.4	171	90%	160	84%	165	87%
[3] Swallowed by Patient	0.1	19	10%	19	10%	19	10%
[15] Sent To Hg Recycle	0.0	0	0%	32	17%	132	70%
[16] Sewer Discharge	4.9	171	90%	139	73%	39	20%

This example operatory is equipped with a flush-flow cuspidor that drains into the vacuum system. Some cuspidors have different plumbing arrangements. Also, this example has a vacuum pump with a continuous flow of seal water, i.e., a "wet" vacuum system. Three alternative levels of BMP use are shown.

Exhibit 6
Example Hg Mass Balance - One Removal Procedure



Location	Flow (l)	A: Few BMPs		B: Some BMPs		C: All BMPs	
		Hg Mass (mg)	%	Hg Mass (mg)	%	Hg Mass (mg)	%
[1] One Amalgam Removal	1.0	360	100%	360	100%	360	100%
[2] Suction Wand	0.9	252	70%	252	70%	288	80%
[3] Swallowed by Patient	0.1	36	10%	36	10%	36	10%
[4] Mouthwash into Cuspidor	0.5	**72**	**20%**	**72**	**20%**	36	10%
[5] Vacuum Trap Capture	0.0	194	60%	188	60%	191	60%
[6] Pass Vacuum Trap	0.9	130	40%	125	40%	127	40%
[7] Amal. Separator Capture	0.0	0	0%	0	0%	**0**	**0%**
[8] Pass Amalgam Separator	0.9	65	100%	63	100%	64	100%
[9] Vacuum Screen Capture	0.0	65	50%	63	50%	64	50%
[10] Pass Vacuum Pump Screen	0.9	65	50%	63	50%	64	50%
[11] Cuspidor Trap Capture	0.0	0	0%	11	15%	5	15%
[12] Pass Cuspidor Trap	0.5	72	100%	61	85%	31	85%
[13] Total Capture	0.0	259	72%	261	73%	260	72%
[14] Release to Sinks	0.0	259	100%	**199**	**76%**	**5**	**2%**
[17] Vacuum Pump Seal Water	5.0	0	0%	**0**	**0%**	**0**	**0%**
[18] Cuspidor Water Flow	2.0	0	0%	0	0%	0	0%
[19] Cuspidor Wastes into Trap	2.5	72	100%	72	100%	36	100%
[20] Waste into Vacuum Trap	1.4	324	90%	313	87%	319	89%
[3] Swallowed by Patient	0.1	36	10%	36	10%	36	10%
[15] Sent To Hg Recycle	0.0	0	0%	63	17%	255	71%
[16] Sewer Discharge	5.9	324	90%	261	73%	69	19%

An average amalgam removal procedure [1] generates 0.36g of waste Hg. The amount of this Hg that is discharged [18] depends upon the level of BMP use.

Conclusions

How much amalgam ultimately reaches the sewer system depends upon the type of vacuum system and the diligence with which the office employs Best Management Practices (BMPs) for amalgam waste capture.

- Exhibits 5 and 6 show that, if no BMPs are used, then about 90% of the waste amalgam is discharged to the sewer.

- If all feasible BMPs are used, this discharge is significantly reduced, to the level of about 20% of the waste amalgam generated by each placement or removal procedure.

- The following BMPs are for reducing the amounts of amalgam leaving the office via the sewer, medical waste, ordinary trash, and plastic recycling. This list is adapted from the March 2004 ADA recommendations for amalgam wastes.

  Collect and store amalgam waste in accordance with instructions of your recycler or hauler. Use a large well-sealed plastic container to hold amalgam wastes for pick up.

  - used chairside traps (vacuum & cuspidor);
  - used screens from vacuum pump;
  - used amalgam capsules;
  - non-contact scrap amalgam;
  - amalgam separator wastes; and
  - extracted teeth w/ amalgam restorations.

  Use a vacuum line disinfectant that does not contain bleach or other chlorine-containing formula. See ADA factsheet.

  Use pre-measured amalgam capsules (e.g., 1-spill & 2-spill sizes).

  Dispose of amalgam wastes properly:

  - hauled by hazardous waste company;
  - shipped to licensed recycler; or
  - taken to county hazardous waste center.

Install an amalgam separator in the vacuum system.

Train staff annually in proper handling and disposal of amalgam materials and fixer-containing solutions.

Further reductions in amalgam discharges to the sewer require the installation of a separator device in the vacuum system. With such a device in place, the net sewer discharge will be about 5% to 7% of the total waste amount generated by amalgam placement or removal procedures.

More Information

The WRPPN Dental P2 Website has other factsheets that describe Amalgam BMPs and Amalgam Separator Devices. Information is also available on the presentations page of this website.

http://www.westp2net.org/dental/index.cfm

American Dental Association, Best Management Practices For Amalgam Waste, March 2004. Available from the ADA website: http://www.ada.org.

Barron 2002 - Barron, Thomas, Mercury Headworks Analysis for 2000, Palo Alto RWQCP, March 2001 (Revised January 2002).

San Francisco Public Utilities Commission
http://sfwater.org/detail.cfm/C_ID/1844/MC_ID/4/MSC_ID/85/MTO_ID/159

San Francisco Department of the Environment
http://www.sfenvironment.com/aboutus/toxics/dentistry/resources.htm

Watson 2002b - Watson, P., and A. Adegbembo, Study of the Fate of Mercury from the Placement and Removal of Dental Amalgam Restorations, Royal College of Dental Surgeons of Ontario. Part I: (Watson 2002a). Part II: (Watson 2002b).