How and Why M.A.R.S. Does What it Does

M.A.R.S is an environmentally conscious mercury capture and containment company specializing in amalgam separation and waste water treatment for the Dental Community.

M.A.R.S. has been manufacturing the BOSS amalgam separator since 2005. This separator was designed to be significantly different from the existing amalgam separators that were available to the market. At that time, the only other unit to claim "Ion Exchange" potential was the SolmeteX Hg5 system which used only 3 grams of media and had a calculated life expectancy of 4-5 days in the dental waste water environment. The M.A.R.S. system uses over 1 pound of sulphur impregnated carbon as found in coal fired plant stack scrubbers combined with a chemical product that is engineered for ionic capture of mercury.

At M.A.R.S., we are continuously researching new products to enhance our mercury capture rate and our containment capabilities. Early in 2014, M.A.R.S. became aware of a product that could be added to our existing ion exchange system that had the potential to greatly increase the capture and containment of not only solid mercury but a very large percentage of the soluble mercury in the Dental Waste Water. This addition to the LibertyBOSS has increased the efficiency of our amalgam separator that it has been shown to have become a combination water treatment/polishing system.
M.A.R.S. has also worked closely with the City of Toronto Water Department to discuss methods of establishing inspection and service verification methods for Dental practices that are non-intrusive and verifiable. This has led to a revised "Pollution Prevention Plan" that is sent by email to the Dental practices that need to be compliant. The e-mail lists are supplied by the State Dental Associations.

M.A.R.S. has developed a "Certificate of Compliance" that shows installation date, practice information and expected service life of the LibertyBOSS. This allows the City and the practice to work together to ensure compliance and to minimize and facilitate the reporting function of the regulation.

M.A.R.S. has always guaranteed our product and the service life of the separator. To our knowledge, we are the only company that offers assurances that our product will function as advertized.
The City of Toronto's "P2" plan (Pollution Prevention) is attached for your review. It should be noted that M.A.R.S. has identified a few minor changes to this document that may improve its clarity and effectiveness. A meeting with the City of Toronto Water Department to discuss these changes is being arranged for February, 2015.

It has been our experience that POTW's feel that this kind of self-governed compliance reporting is efficient and does not place any stress on their budgets, in fact it would relieve a lot of the inspection aspect of supporting the new regulation. The last step in the refinement of the reporting document is to have an accurate estimate of the service life of the major amalgam separators sold in the City of Toronto. This information will be compiled from major distributor reports of actual installations. The report is not intended to be a guarantee by the Manufacturers, but a general estimate of the amount of annual service required by different amalgam separators.
As part of M.A.R.S.' ongoing Research & Development, we have used the aforementioned new polishing media to design an aftermarket product to enable more efficient soluble mercury capture that

can be used with any amalgam separator. This product is inexpensive and can be serviced easily by the dental staff to minimize the cost. It uses a media carrier that dental offices already know and use.

Addressing the question of the containment of mercury and how long it should be kept in a Dental office.

- Primarily, the standard BMP's refer to contact and non-contact amalgam collected from the dental operatory. As stated in the BMP's this material is to be collected and stored in a sealed container covered with a liquid to avoid the creation of hazardous mercury vapour.
- Secondly, sludge that is collected in an amalgam separator. Amalgam separators are not containers, they are in fact process equipment designed to collect and hold mercury amalgam. As process equipment, like thermostats, blood pressure cuffs, light bulbs and many other tools and equipment found in a dental office, the separators do not fall under the BMP's category of "container". This explanation was accepted by the N.Y. State Department of Environmental Conservation in June, 2007 (letter attached).
- Further, as stated in the NY State DEC letter, the BMS's clearly state that "amalgam separators are to be serviced according to the manufacturers specifications" .

This situation is also evidence of the requirement for clear and detailed definitions that are sent not only to the dentist and their staff but to the manufacturers and especially to the service companies that install the units. The service company technicians, due to the trust placed in their opinion can have a powerful influence on the dentist in issues that originate in the dental utility room.
Regarding the possible effect of the regulation on low income practices, M.A.R.S. has been working with all sizes of offices and has found that the purchase and maintenance of an amalgam separator by the low income or part-time offices can be a challenge due to the onetime cost which disrupts the already sensitive cash flow. In such cases M.A.R.S. has offered payment terms or leasing agreements to minimize the effect of the purchase and help stabilize the Dentist's cash flow.

Verification of dental office compliance with the new regulation need not be a burden on the region or the POTW and definitely NOT the Dentist. The City of Toronto has developed a "P2 Plan" (Pollution Prevention Plan) that is simple to activate and easy for the doctors to fill out. This also gives the POTW the information it needs to either accept the data or to send an inspector for data verification. I have included an actual P2 Plan for your review. I am aware that the City is also investigating the possible issuance of tickets by the Enforcement Officers for violations by reducing the penalty to that of a traffic ticket. This small charge should be enough to gently ensure compliance. In areas where POTW manpower is at a premium, it is suggested that Dental students be hired as summer employment and with a 1/2 day training could blanket the area in question and report any suspected non-compliant practices for inspection by full-time POTW Inspectors. This would give the students a different view of the Dental industry and a gentle reminder to the Dentist that compliance is not a suggestion but in fact a regulation. The students could also be trained to take water samples if required.

One of the important things for inspectors to identify is the location of the "Solids Collector" in the vacuum line. Sometimes the Solids Collector is placed before the amalgam separator. M.A.R.S. and the City of Toronto agree that solids collections must be after the separator for a number of reasons:

- If placed before the separator all the material collected must be treated as toxic mercury waste and disposed of as such. This costs the Dentist extra money that is not required. This practice of putting the Solids Collector before the separator was initiated by certain separator companies in order to relieve their separator from the burden of all the material entering and "plugging up" their unit. In fact, they were using the solids Collector as a pre-filter for their separator. This practice can cost the dental office $1,000

or more per year, which is an unnecessary expense. A Toronto Study has shown that approximately 90% of offices in Toronto are set-up in this manner and it was also reported that a significant percentage of the Dentists or their Technicians simple flush these collectors down the drain to clean them, returning the captured mercury back into the sewer system.

This travesty is simply a function of poor communication about the regulation and inaccurate explanation to the Dentist by his Technician. Therefore, accurate procedures should be sent to the Dentist, the Dental Distributor's Technicians and Reps as well as the Separator manufacturers. Companies who chose not to comply should be removed from a National Acceptable separator list which can be updated annually or bi-annually.

Tests by Mr. Bill Purves of Purves Environmental have shown that the mercury levels (solid and soluble) in the discharge water from a Dental office are approximately 100 times lower with the LibertyBOSS when compared to the SolmeteX separator and approximately 150 times lower than the DRNA unit. These tests have also shown the existence of a large percentage of soluble mercury that is not calculated or accounted for in the existing ISO 11143 testing.

M.A.R.S. has been selling a basic ion exchange amalgam separator since 2005. Over the past 10 years we have continued to improve the technology into our existing system which has a full 3-stage ion exchange program beside a large settling chamber.

As seen in the attached "Purves Environmental Dental Separator Study #2", we are now able to achieve reductions to the 500 ng/L range consistently. This is up to 150 times better mercury removal and containment than competitive settling type separators. At the same time, M.A.R.S. has kept the costs down and in most cases; we are less expensive than the most popular separators.

Additions to the standard BMP's in Dental offices should include the use of line cleaners that have a pH between 6 and 8 as well as be non-foaming and bio-degradable. These are two very important features of an effective evacuation line cleaner. It is important to have a line cleaner that also effectively reduces bio-film build-up in the vacuum lines as well as in the separator body.

Excessive bio-film build-up on the vacuum line walls creates a laminar flow situation that stresses the vacuum pump. Of greater interest for this discussion, is the fact that bio-film also traps and holds mercury. With the use of acidic aggressive cleaners, we have the likelihood of large section of bio-film releasing and plugging some separators. The LibertyBOSS was designed with large inlets and outlets to handle such large releases and the BOSS has a large settlement chamber to eliminate blockage from this kind of release.

It is possible in most, if not all, dental offices to retrieve a water sample for testing to a numeric limit. This could be set-up at the pump discharge point just prior to the drain. In my opinion, this kind of testing should only be done in cases where the POTW's wishes to set a discharge baseline limit for the area. This numerical data could assist the treatment plants in identifying specific problem areas in their region.

The media used in the LibertyBOSS amalgam separator/water treatment system is also available in a format that could be used by the POTW's to further reduce the Hg levels in their primary settling tanks. A few pilot projects have been set-up and have shown extremely good results.

One of the primary issues in the capture and containment of mercury is the recognition of the greater than expected amounts of soluble mercury that is being created when mercury and water are in direct contact. The Purves Studies (attached) show us the amount of mercury that becomes soluble in water in only a few hours.

This data also demonstrates the real inefficiencies of the present ISO 11143 Standard for certification of amalgam separators. Since it is unlikely that the ISO would consider changing their now antiquated certification testing procedures to a test that includes soluble mercury, I believe that the POTW's should have the power to require testing for soluble mercury in their respective regions. The required test is inexpensive and readily available.

In larger practices, such as dental schools, the same rules and challenges apply only on a larger scale. At present the only available solution is to rearrange the piping in order to accommodate multiple separators connected in parallel. Using a manifold to split the flow into as many smaller lines as needed to reduce the individual flows to a manageable rate.

In light of the large amount of soluble mercury created in standing water (test results attached), we must rethink the entire "holding tank" concept. M.A.R.S. is in the midst of designing a process that will be modeled after a POTW pilot project. The system would include inline equipment specifically geared to the removal of soluble mercury.

A secondary concern that is as large as the Dental issue is the use by the POTW's of the "nutrient rich" sludge from the primary settling tanks in their treatment process. Apart from the soluble mercury that is passing through the system virtually untouched, any solid mercury in the flow is being collected in the sludge. Presently this sludge is either incinerated, land filled, or used as fertilizer. Unfortunately none of these practices are environmentally acceptable or medically safe. Since mercury can become vaporous at low temperatures, the incineration process only serves to make the mercury content airborne. Basically they are simply sending their mercury problem to the next county or state.

The landfill solution, although the best of the solutions, still holds the very real possibility of mercury leeching into the surrounding soil and water table.

The creation of fertilizer by mixing sludge with wood chips again sends the mercury airborne because this process requires composting which achieves temperatures in excess of 130°F and the process can last for three weeks. This process insures that there is no mercury in the fertilizer however properties downwind of the process yard will be experiencing elevated levels of mercury in their land.

Cremation is an industry that also created airborne mercury issues due to the remaining amalgam fillings in the bodies being cremated. The only solution that may be acceptable is the extraction and collection of the teeth for proper disposal of the amalgams.

Another point of concern is the inspection frequency required for amalgam separators. This topic is challenging due to the variety of sizes and styles available. Many sedimentation style separator units simply calculate the estimated daily flow from the operatories and supply a unit that is able to hold it after the heavy sludge settles, the water (and soluble mercury) is decanted and sent to the sewer system. Others use upper chambers to separate the air and water and direct the sludge to a lower filter, however when the upper chamber plugs, as it very often does, due to pastes and bio-film build-up, then the unit

is basically in overflow mode and the separation efficiency is reduced dramatically. Even the M.A.R.S. LibertyBOSS can experience reduced efficiency if the unit is not serviced properly.

Inspection and maintenance of separators is a critical element in the efficient operation of amalgam separators. All separator manufacturers have the capacity and knowledge of their product to give relatively accurate service life estimates to the purchasers. There have been studies that compare the service life of assorted separators based on reports from Dental distribution companies. One such comparison has been requested by the City of Toronto and is expected before the end of February, 2015.

In summation, the "Best Available Technology" has been sold in the Dental market for approximately 10 years. The increase in awareness of the LibertyBOSS system has been due to the new evaluation of the actual amount of soluble Hg in the dental waste water and its effect on the POTW's. The Technology and robust design that we combine in this equipment creates a separator that is built to capture the maximum amount of both solid and soluble mercury and safely contain it for recycling.

Generally speaking, the amalgam separator industry has been functioning quite well relative to existing ISO standards. However, when we include the large amount of soluble mercury that is created in standing water I feel that the industry as a whole needs to step-up and address the current issues. As an industry we must be able to respond to respond to new challenges that are created or discovered. As with any other industry those who are unable or unwilling to adapt will make way for companies that will search for solutions to new challenges.

As an industry that has a moral and ethical responsibility to the community we serve and the environment, we need to maintain a greater level of transparency and hold ourselves to a higher standard.

M.A.R.S. has created an amalgam separator with an internal polisher and an add-on system that could assist all Dental Practices in their efforts to reduce the amount of mercury discharge from their offices.

The highest level of mercury capture that could be achieved is with the efforts of all the groups involved, the Dental office using "Best Available Technology" and the POTW's using the "Best Technology" in their plants. The last part of the puzzle is to identify and reduce the release of already captured mercury back into the environment as vaporous discharge from Municipal Waste Disposal efforts.

Thank you,

Mike Darcy
President
M.A.R.S. Bio-Med

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