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## IS THERE MERCURY In Your Industrial Wastewater Discharge?



Designer's Guide / Fire Protection / Code Update

# IS THERE MERCURY IN YOUR INDUSTRIAL WASTEWATER DISCHARGE?

## Abstract

An assessment of sampling locations for three industrial wastewater effluent piping systems is presented. The assessments provided demonstrate that by installing sampling ports at the appropriate location along an effluent stream's piping system, truly representative samples can be collected. These real and accurate results scientifically prove that a specific industrial wastewater discharge does not contain mercury levels that will trigger regulatory enforcement action.

## INTRODUCTION

Environmental regulatory agencies are trying to get a handle on mercury compounds found in industrial wastewater discharges, and they are looking to these industries to identify which of their waste streams discharge organic and/or inorganic mercury. In 1988, the Federal government introduced a ban on ocean dumping. This ban includes any bio-solids that were generated by publicly owned treatment works (POTWs). All POTWs currently are required to find alternative disposal methods for the bio-solids. The disposal method used by these industries is dependent on a large number of pollutant concentrations, including mercury. The allowable limits for mercury, and other pollutants, are regulated by **Chapter 40 Code of Federal Regulations Part 503 (40 CFR 503)**.

Mercury discharge concentrations are strictly monitored and reuse or disposal of bio-solids may not be acceptable at certain concentration levels. So the question falls to industries, is there mercury in your industrial wastewater discharge? Industries discharging wastewater with mercury levels above the regulatory action limit are mandated by the regulations to react and bring wastewater discharge mercury below the acceptable regulatory limit.

The first approach industries typically use to reduce the mercury discharges is to look at the source of the industry's process and identify alternative materials to be used with little or no mercury contamination; that is, Source Reduction methods. The next step many facilities will use, after source reduction, is to install costly pretreatment systems.

It is the intent of this presentation to suggest that the approach be redirected, and the facility should first determine if the discharge sampling location and sampling techniques truly provide representative data.

## BACKGROUND

The Environmental Protection Agency's (EPA) current mercury analytical method measures mercury at extremely low levels. Many laboratories can achieve mercury detection limits at 0.5 ppb Hg, and many regulatory agencies require a mercury action level for industrial wastewater discharge at 1.0 ppb Hg. As a result of this ability to measure mercury at this low level of detection, it is critical that the sampling be done properly and according to the regulatory agency's specifications. These stringent sampling guidelines include the following requirements: agency-approved sampling plans and protocols; proper sampling equipment that is properly cleaned; certified/trained sampling personnel; scrupulously cleaned sampling containers, made of the appropriate material to preserve the integrity of the sample; sufficient storage and shipping supplies to ensure proper storage conditions and security; finally a representative sampling location to obtain a homogeneous and unbiased sample from the wastewater. These strict sampling guidelines are necessary to minimize and/or eliminate any sample contamination that can result in analysis yielding "false positives" for the analytes in question, in this case mercury.

Of the aforementioned good sampling requirements, the sample location is perhaps the most critical in the waste stream. In order to provide samples that are representative, it is imperative that the proper sampling location be identified. Regulatory agencies typically do not address the problem of representative samples versus non-representative samples. The regulatory agencies require only that a wastewater discharge sample be taken after treatment and prior to mixing with any other stream being discharged to the environment. Consequently, even though industry is responsible to meet the discharge limit, it also is their responsibility to identify the proper sample technique and a truly representative sampling point.

## METHODS

### Industrial Wastewater Sampling Techniques

An important aspect of industrial wastewater sampling is to ensure that the sample is taken during flow conditions. Non-flowing wastewater streams do not provide a representative sample, as discussed later (*see DISCUSSION: Considerations When Choosing a Representative Sample Location*). A representative industrial wastewater sample must be homogeneous; this can not be achieved when the flow is stagnant.

The Federal government has identified those methods that are acceptable for industrial wastewater analysis (*see 40 CFR Part 136*). Each analysis specifically states the appropriate container and preservation method. These methods should be followed for either grab or composite samples. It cannot be stressed enough that all sampling personnel should be well versed in the methods referenced in **40 CFR Part 136**, and that they meet the training requirements of the regulatory agency. Also, any laboratory used to perform the analysis of the collected samples needs to be certified by the EPA or State Department of Environmental Protection (DEP) to legally report the specific wastewater analyte concentrations.

## RESULTS

### A Case Study in Choosing a Representative Sampling Location

Interest in writing this article stems from observations made at three medical research facilities that obtained very different mercury sampling results when the sampling locations were relocated to provide truly representative samples. All three medical research facilities went from mercury concentrations that exceeded the regulatory action limit to achieving sampling results consistently below the regulatory action limit, once a representative sampling location was chosen and identical sampling techniques were used. Changing the sampling location to a location that is representative of the discharge, allowed the facilities to achieve acceptable mercury limits and avoiding further regulatory enforcement.

Observations were made at three separate medical facilities where changing the sample location and technique yielded radically different results. Although three facilities were studied, only one facility has the full set of available sampling data from both before and after the sample location change. Practical Applications, Inc. (PAI), reviewed the sampling location at a medical facility which typically exceeded regulatory limits for mercury even after the proper sampling techniques were administered. PAI found that the usual sample port location for these facilities was at the bottom of a horizontal section of a 6" diameter pipe. The horizontal 6" diameter pipe transitions to a 6' section of 2" diameter pipe. The sample port was located at the end of this 6' section of 2" pipe where a set of valves were attached (see **Figure 1A** for where the sampling port was prior to moving the sample location). After examining the sample location and evaluating the sample results, PAI suggested moving the original sampling location to provide more representative results. (See **Figure 1B**). **Table 1** shows the mercury sampling data for the 24 weeks prior to moving the sampling location. **Table 2** presents mercury sampling data for the 11 weeks and 5 consecutive days after the sampling location was moved to a vertical section of pipe. The mercury regulatory limit (see EPA Analytical Method 245.2) for this medical research facility is 1.0 ppb Hg.

The 16 consecutive sample results directly prior to changing the sample location are compared to the 16 consecutive sample results proceeding the sample location change. The 16 sample results prior, violated the 1.0 ppb Hg regulatory limit 62.5% of the time. These 16 sample results exceeded the mercury regulatory limit by an average of 7.43 ppb Hg. The 16 sample results proceeding the sample location change, violated the 1.0 ppb Hg regulatory limit 6% of the time. These 16 sample results proceeding the location change, exceed the mercury regulatory limit by an average of 0.19 ppb Hg.

In this case study, taking a representative sample identified that the frequency and severity of the mercury violations were not at all accurate. Further sampling at the new representative sampling location has provided sampling results consistently below mercury regulatory limits. This medical research facility location is no longer under regulatory enforcement for mercury.

## Medical Research Facility Sampling Results

*Table1. Hg Sampling Concentrations Prior to Sample Location Change*

Week #	Total Hg ppb
1	2.0
2	1.4
3	<1.0
4	<1.0
5	<1.0
6	8.6
7	1.2
8	<1.0
9	<1.0
10	2.5
11	<1.0
12	2.6
13	2.7
14	4.6
15	3.0
16	3.4
17	<1.0
18	32.1
19	3.5
20	1.5
21	<1.0
22	<1.0
23	66.1
24	8.0
25	**
26	**

*Table2. Hg Sampling Results with Moved Sample Location*

Week #	Total Hg ppb
27	
28	<1.0
29	<1.0
30	<1.0
31	<1.0
32	<1.0
33	<1.0
34	<1.0
35	<1.0
36	<1.0
37	<1.0
Day 1	<1.0
Day 2	<1.0
Day 3	<1.0
Day 4	<1.0

*\*\*Trap installed, no sample taken.*

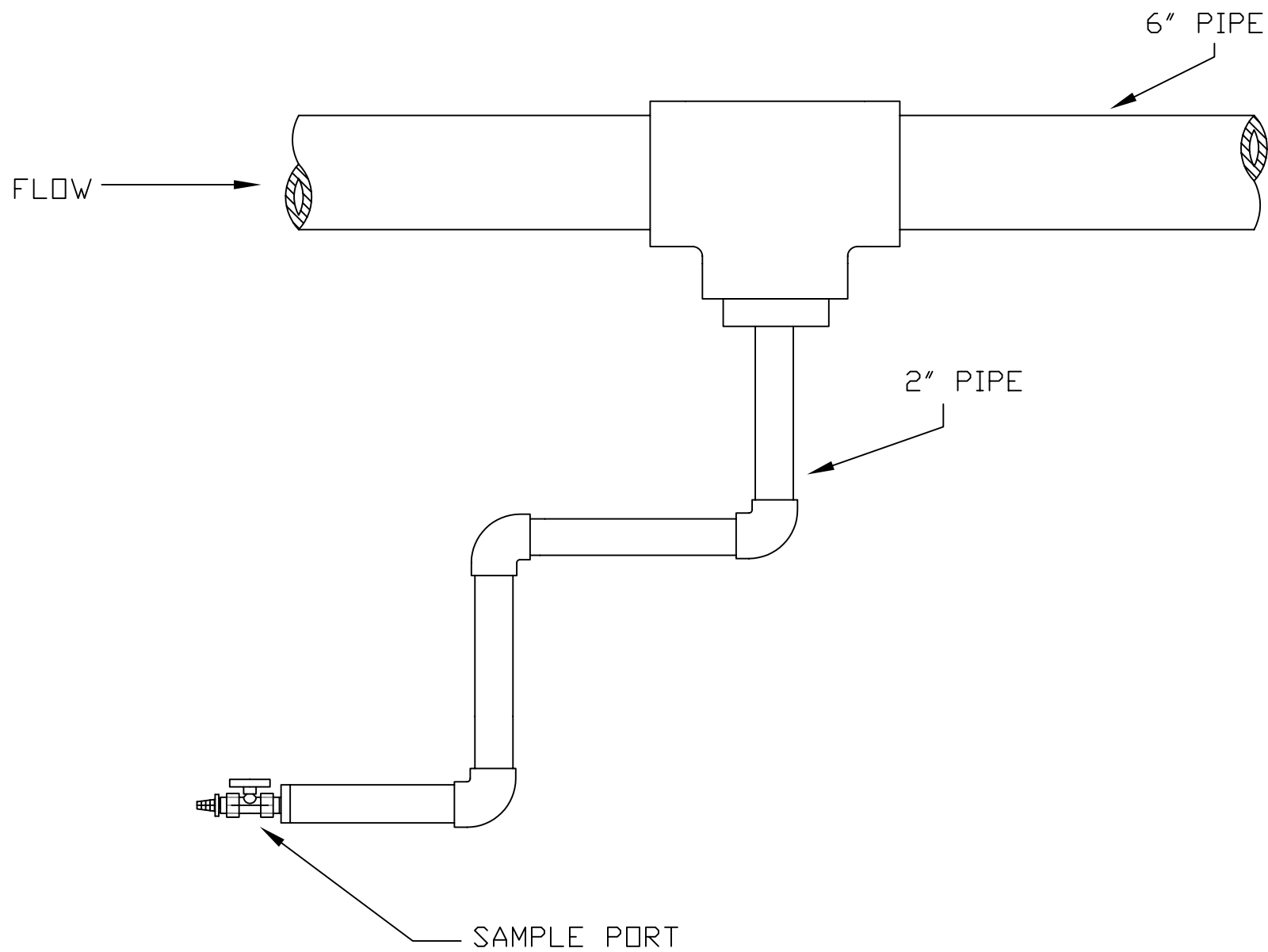


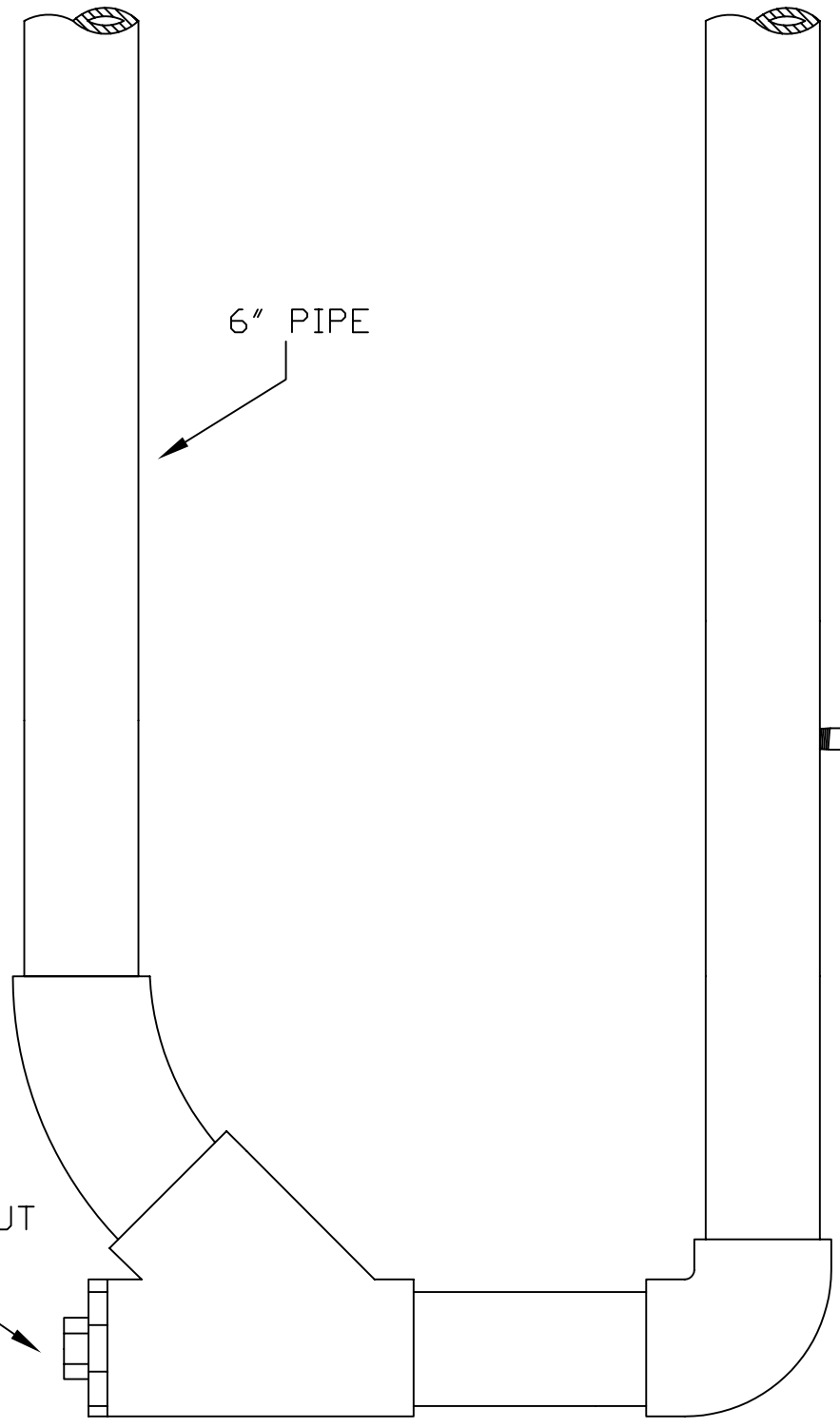
FIGURE 1A  
Original Sampling Configuration  
Practical Applications, Inc.

FLOW

6" PIPE

SAMPLE PORT

CLEAN OUT



**FIGURE 1B**  
Recommended Sampling Configuration  
Practical Applications, Inc.

## **DISCUSSION**

### **Considerations when Choosing a Representative Sampling Location**

Typically many wastewater sources make up the final industrial wastewater discharge. These sources contain a variety of particles, liquids and gases. A representative sampling location must provide the most homogeneous mixture during a sampling event. The variability of material within industrial wastewater streams will stratify in a pipe or closed-system vessel that is not adequately mixed. Massachusetts Water Resources Authority (MWRA) and Medical Academic and Scientific Community Organization, Inc. (MASCO) together have identified in their Mercury Guidance Document, that “Mercury is commonly found at the bottom of sink traps, where mixing does not occur and fallout does”. To choose a representative sampling location an industry must determine where a homogeneous mixture exists in the effluent piping system.

Gravity discharge piping systems are common for most industrial wastewater effluents. A homogeneous mixed wastewater stream can be found in gravity discharge piping system traps. Effluent discharge piping systems are made up of both vertical and horizontal pipe sections. Wastewater flowing in horizontal pipe sections may exhibit stratified flow; a horizontal pipe section allows for the suspended particles to move in distinct layers or stratify along the depth of the flowing stream. Heavier materials settle towards the bottom of the pipe, while less dense materials float to the top of the flowing stream, a process known as classification. Consequently, samples taken from horizontal pipe sections discharging wastewater with a mixture of particles, immiscible liquids, and gases will favor concentrations of a particular layer and not be representative of the entire waste stream.

In contrast, fluid flow in vertical pipe sections typically exhibit mixed flow where suspended material does not stratify. Instead, suspended materials compete with the forces of gravity, particle buoyancy, fluid pressure above the particle and fluid pressure below the particle.

Most gravity drainage systems require traps to prevent sewer gas and odors from escaping into the building and to keep insects and vermin out doors. Traps provide a convenient location since they are configured with vertical piping. In particular, since no net accumulation occurs in a properly designed trap (i.e., the trap does not plug), we can assume that the various components of a wastewater stream (solids, immiscible liquids, and gases) discharged via the gravity pipe system eventually discharge through the trap.

Solids, liquids, and gases entering the bottom of the trap will be forced up the vertical section by a net force that is greater than the gravitational force. In addition, buoyancy forces help carry the various materials to the top of the trap. As with solids, liquid droplets (other than water), and gases, the non uniform shape allows unbalanced drag forces to act on the material causing erratic and non-stable movement as it travels to the top of the trap, in turn, mixing of the various materials occurs. Therefore, the up-flow section of a trap provides a more homogeneous mixture when wastewater is flowing through the trap. This is not true when the trap is stagnant.

## **Once a Sampling Location is Chosen**

Once a sampling location is chosen and the proper trap configuration is in place, the cost to install a new sampling port is typically minuscule.

### *Parts:*

*1/4 in. MPT x FPT PVC labcock \$10.20*

*3/8 in. x 1/4 in. PE Hose Barb w/ Male Connector \$0.40*

The labor involved in completing this type of sample port installation is minimal, as long as there is low flow through the system. These costs are low enough for a company to incur and conduct sampling to verify data prior to making a large investment for a new and unproven treatment technology.

## **SUMMARY**

It is important to be compliant and reduce mercury and other pollutant discharges to the sewer system and ultimately to the waterways. It is also important to become aware of the sampling techniques and location to ensure that the most representative sample is taken.

The following should be considered to achieve a truly representative sample:

1. Verify that all samples are taken under flow conditions
2. Verify that the sampling equipment is clean to eliminate false contamination
3. Verify that the sampling personal are trained in accordance with the governing regulations (Massachusetts requires DEP certified laboratory personal to complete all wastewater sampling)
4. Verify that the laboratory completing the analysis is certified by the DEP for the specific pollutant
5. Verify that the sampling location is one that will provide a homogeneously mixed sample of the wastewater discharge.