Introduction to the National Pretreatment Program

An Online Continuing Education Course for Engineers

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Preface

The industrialization of the United States brought with it a level of pollution never before seen in the country. By the 1960s scenes of dying fish and burning rivers were repeated regularly on the evening news. In response to such critical environmental problems, in December 1970 the President of the United States created the U.S. Environmental Protection Agency (EPA) by executive order.

In 1972 Congress passed the Federal Water Pollution Control Act, also known as the Clean Water Act (CWA), to restore and maintain the integrity of the nation's waters. The goals of the CWA are to eliminate the introduction of pollutants into the nation's navigable waters and to achieve fishable and swimmable water quality levels. The CWA's National Pollutant Discharge Elimination System (NPDES) Permit Program represents one of the key components established to accomplish the goals of the CWA. The NPDES Permit Program generally requires that point source discharges of pollutants to waters of the United States, i.e., *direct dischargers*, obtain an NPDES permit. The CWA also established substantial penalty authority for noncompliance with NPDES permits.

In addition to addressing these direct discharges, the CWA also established a regulatory program to address *indirect discharges* from industries to publicly owned treatment works (POTWs) through the National Pretreatment Program, a component of the NPDES Permit Program. The National Pretreatment Program requires industrial and commercial dischargers, called *industrial users* (IUs), to obtain permits or other control mechanisms to discharge wastewater to the POTW. Such a permit may specify the effluent quality that necessitates that an IU pretreat or otherwise control pollutants in its wastewater before discharging it to a POTW.

Certain industrial discharge practices can interfere with the operation of POTWs, leading to the discharge of untreated or inadequately treated wastewater into rivers, lakes, and other waters of the United States. A discharge that causes *interference* inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use, or disposal and therefore causes a violation of any requirement of the POTW's NPDES permit. Some pollutants are not amenable to biological wastewater treatment at POTWs and can pass through the treatment plant untreated. This *pass through* of pollutants affects the receiving water and might cause fish kills or other deleterious effects. Even when a POTW has the capability to remove toxic pollutants from wastewater, the pollutants can end up in the POTW's sewage sludge, which might then be processed into a fertilizer or soil conditioner that is land-applied to food crops, parks, or golf courses or elsewhere.

The General Pretreatment Regulations of the National Pretreatment Program require all large POTWs (those designed to treat flows of more than 5 million gallons per day) and smaller POTWs (that accept wastewater from IUs that could affect the treatment plant or its discharges)

to establish local pretreatment programs. These local programs must enforce all national pretreatment standards and requirements in addition to any more stringent local requirements necessary to protect site-specific conditions at the POTW.

This course introduces terminology, basic concepts, and general responsibilities under the National Pretreatment Program.

Chapter 1: POTWs And The Need For The Pretreatment Program

Sewage Treatment

Publicly owned treatment works (POTWs) collect wastewater from homes, commercial buildings, and industrial facilities and transport it via a series of pipes, known as a collection system, to the treatment plant(s). Collection systems can flow entirely by gravity or can include lift stations, which pump the wastewater via a force main to a higher elevation from which the wastewater can then continue by gravity. Ultimately, the collection system delivers this sewage to the treatment plant. The treatment plant then removes harmful organisms and other contaminants from the sewage so the wastewater can be discharged safely into a receiving stream. Without treatment, sewage creates bad odors; contaminates rivers, lakes, and water supplies; and spreads disease. There are more than 16,000 sewage treatment plants in the United States treating more than 32 billion gallons per day of wastewater. There are approximately 1,600 POTWs that have approved pretreatment programs, and there are 20,630 significant industrial users (SIUs) discharging to those POTWs. Many of the POTWs manage more than one sewage treatment plant.

Generally, POTWs are designed to treat only domestic sewage. The typical POTW treatment process consists of primary and secondary treatment, disinfection (to kill any remaining pathogens), and some form of solids handling. Primary treatment is designed to remove large solids (e.g., rags and debris) and smaller inorganic grit. Typical primary treatment operations include screening and settling. Secondary treatment removes organic contaminants by using microorganisms to consume biodegradable organics. Activated sludge, trickling filters, and rotating biological contactors are examples of common secondary treatment operations. Depending on effluent discharge requirements, POTWs can perform advanced treatment operations, such as nitrification (to convert ammonia and nitrite to the less-toxic nitrate form of nitrogen), denitrification (to convert nitrate to molecular nitrogen), and physical-chemical treatment (to remove dissolved metals and organics). After treatment is complete, effluent is discharged to a receiving stream, typically a creek, river, lake, estuary, or ocean. Some POTWs might apply treated effluent directly to golf courses, parkland, or croplands. Industrial users (IUs) are increasingly implementing measures to reuse effluent. For example, effluent can be used as makeup water in cooling towers and boilers.

Both primary and secondary treatment processes generate waste solids, known as sewage sludge or biosolids. Sludge from the treatment process can be used as fertilizer or soil conditioner, disposed of in a landfill, or incinerated in a sewage sludge incinerator with the ash disposed of in a landfill.

As described earlier, POTWs are designed to treat typical household waste, biodegradable commercial waste, and biodegradable industrial waste. The regulations at Title 40 of the *Code of Federal Regulations* (CFR), section 401.16, define five contaminants as *conventional pollutants*. These conventional pollutants, identified in figure 1-1, include the specific pollutants that are expected to be present in domestic discharges to POTWs. Commercial and industrial facilities may, however, discharge *toxic or non-conventional pollutants* that the treatment plant is neither designed for nor able to remove.

Biochemical Oxygen Demand (BOD)
Total Suspended Solids (TSS)
Fecal Coliform
pH
Oil and Grease (O&G)

Figure 1-1. Conventional pollutants.

Need For The Pretreatment Program

As noted earlier, POTWs are not designed to treat most toxic or non-conventional pollutants that are present in industrial waste. Consequently, discharges from both industrial and commercial sources can cause problems at POTWs and can have detrimental effects on the water quality of the receiving waterbody. The undesirable effects of those discharges can be prevented by using treatment techniques or management practices to reduce or eliminate the discharge of the contaminants. The act of treating wastewater before discharge to a POTW is commonly referred to as *pretreatment*. The National Pretreatment Program, published in 40 CFR Part 403, provides the regulatory basis to require nondomestic dischargers to comply with pretreatment standards to ensure that the goals of the Clean Water Act (CWA) are attained. The objectives of the National Pretreatment Program are stated in 40 CFR 403.2, as follows:

- Prevent the introduction of pollutants into a POTW that will interfere with the operation of the POTW, including interference with its use or disposal of municipal sludge
- Prevent the introduction of pollutants into a POTW that will pass through the treatment works or otherwise be incompatible with such works
- Improve opportunities to recycle and reclaim municipal and industrial wastewaters and sludges.

The two key terms used in EPA's objectives for the National Pretreatment Program, *interference* and *pass through*, are defined in 40 CFR 403.3(k) and (p):

> ***Interference:*** A discharge which, alone or in conjunction with a discharge or discharges from other sources, both:

- Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal, and

- Therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations):

  CWA section 405; the Solid Waste Disposal Act (including the Resource Conservation and Recovery Act and state regulations contained in any state sludge management plan prepared pursuant to subtitle D of the Solid Waste Disposal Act); the Clean Air Act; the Toxic Substances Control Act; and the Marine Protection, Research and Sanctuaries Act.

Pass Through: A discharge that exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation).

As outlined in EPA's objectives, toxic pollutants can pass through the treatment plant into the receiving stream, posing serious threats to aquatic life, human recreation, and those consuming fish and shellfish from the waters. Pass through can make waters unswimmable or unfishable, in direct opposition to the goals of the CWA. It can also interfere with the biological activity of the treatment plant, causing discharges of untreated or inadequately treated sewage.

Even where the POTW has the capability to remove the toxic pollutants, the toxic pollutants can end up in the sewage sludge, thereby limiting sludge disposal options or increasing the cost of disposal. Incinerating contaminated sludge can release toxic emissions into the atmosphere. Toxic metals removed in primary treatment can affect the efficiency of sludge digestion, a process that uses bacteria to stabilize sludge solids. For example, chromium can inhibit reproduction of aerobic digestion microorganisms, thereby disrupting sludge treatment and producing sludge that must be disposed of with special treatment. Uncontaminated sludge, on the other hand, can be used as fertilizer or soil conditioner, thereby improving the productivity of land. Many municipalities apply treated sewage sludge to pastureland or parkland; that would not be an option if the sludge were contaminated.

Gases or vapors from volatile organics discharged to sewer systems can accumulate in the head space of sewers, increasing the likelihood of explosions that could cause significant damage. Probably the most well-known adverse effect from industrial discharges to POTWs in the United States is the explosion in Louisville, Kentucky, that occurred in 1981. The explosion was a result of excessive discharges of hexane into the collection system. The hexane in the pipes eventually ignited and destroyed more than 3 miles of sewers and roadways, causing $20 million in damage. Discharge limitations and management practices to control slug discharges have significantly reduced the likelihood of future catastrophes like that explosion.

Discharges of toxic organics can also result in the release of poisonous gas. That occurs most often when acidic wastes react with other wastes in the discharge. For example, cyanide and acid, both present in many electroplating operations, react to form highly toxic hydrogen cyanide gas. Similarly, sulfides from leather tanning can combine with acid to form hydrogen sulfide, another toxic gas. Such gases can be highly dangerous to POTW collection system operators as they perform their duties. Other problems associated with toxic discharges (summarized in figure 1-2) further document the urgency of keeping toxics out of collection systems and POTWs.

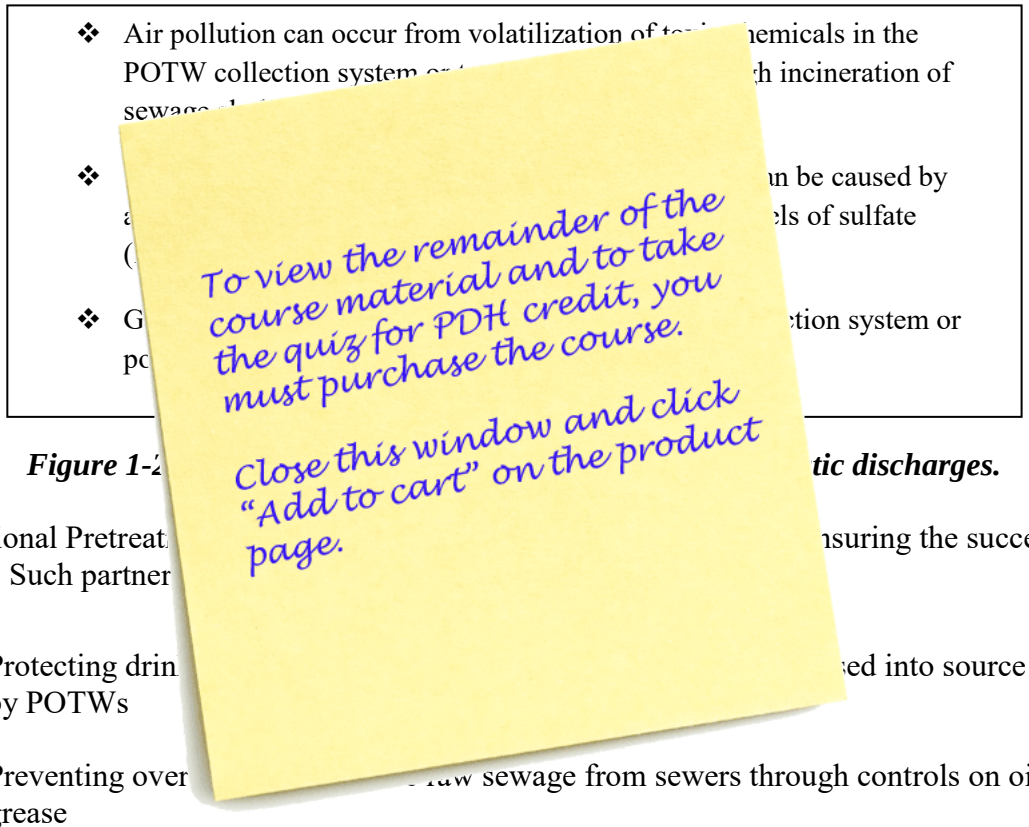

Figure 1-2 ***tic discharges.***

The National Pretreat nsuring the success of POTWs. Such partner

- Protecting drin ed into source waters by POTWs
- Preventing over aw sewage from sewers through controls on oil and grease
- Extending the life of the nation's wastewater infrastructure through EPA's Four Pillars of Sustainable Infrastructure Initiative. EPA believes that better management practices, efficient water use, full-cost pricing of water, and a watershed approach to environmental management can all help utilities to operate more sustainably now and in the long term.
- Worker safety by protecting workers from harmful fumes through limits on discharging dangerous gases and gas-forming substances
- Homeland security by ensuring proper disposal of waste from decontamination showers.

The National Pretreatment Program is charged with controlling toxic, conventional, and non-conventional pollutants from nondomestic sources that discharge into sewer systems, as described in CWA section 307(a). The list of pollutants appears in the *Code of Federal Regulations* at 40 CFR 401.15.