Water Treatment Plant Residuals

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Many water treatment facilities generate waste, known as "residuals," which must be properly treated and disposed of. Residuals generally come from two main treatment processes: clarification and filter backwashing which are components of treating both surface water and groundwater. Surface water residuals are comprised of wide range of constituents from suspended particles, dissolved compounds, biological organisms and the coagulant chemicals that help remove them. Groundwater residuals typically consists of iron and manganese and the coagulant chemicals that are sometimes used to help remove them.

The residuals collected in the treatment process are most commonly pumped/discharged to either a large basin or, if the infrastructure exists, discharged to the sewer. This article focuses on the on-site handling of residuals.

There are several different styles of 'basins' (also called 'lagoons') the most common being either an infiltration basin or a drying bed. An infiltration basin allows the liquid portion of the residuals to return to the ground while solids accumulate for periodic removal. Sludge drying beds often have a rudimentary sand bed that allows the liquid to percolate through the sand leaving a thicker layer on the top that is allowed to dry into a cake that is periodically removed. Some drying beds are designed to allow the cake to go through a winter freeze that further solidifies the cake making it easier to remove. The most effective basin designs have the ability to remove the cleaner water from the top (decanting) and are comprised of multiple cells whereby individual cells can be taken offline for dredging/cleaning. In some cases the decant water is recycled back to the head of the treatment plant.

Mechanical equipment can also be used to further dewater the residuals. This can be done in conjunction with the basin designs described above or separately without the existence of a basin. The main goal of mechanical dewatering equipment is to reduce the water content of the residuals as much as possible. In general, the dryer the residuals the easier and cheaper it is to dispose of. Examples of mechanical methods of dewatering include: belt filter presses, centrifuges, and frame presses.

There are several options for the final disposal of the thickened residuals. Landfills are the most common option. Land application, which is a method of mixing the residuals with soil for open land or farmland can sometimes be used. Beneficial reuse is sometimes an option whereby the material is further dried and incorporated into fertilizers or potting soil. In all of the final disposal options the material must be tested to meet the standards of the receiving entity and comply with all state and federal regulations.

If you are interested in learning more about residuals handling in Massachusetts you can sign up for MWWAs "Navigating Treatment Plant Residuals – Challenges & Solutions for MA Utilities" virtual (Zoom) training being held on September 16th. [Insert Registration Link Here]

1. What is the primary purpose of dewatering water treatment plant sludge?
    a. To reduce their volume and stabilize their properties before disposal.

b. To increase their water content for easier transport.
c. To make them more reactive for further chemical processing.
d. To separate useful chemicals for reuse in the treatment process.

2. True or False? In Massachusetts, all residuals sampling requirements are specified by the MassDEP.
    a. True
    b. False

3. Why is effective residuals management crucial for a drinking water treatment plant?
    a. Compliance with environmental regulations, protection of public health and minimization of environmental impact.
    b. Maximizing the aesthetic appeal of the grounds around the treatment plant.
    c. It is a crucial component of the facility's overall budget
    d. Reduces the need for chemical coagulation.

4. Which of the following constituents of residuals will likely have an impact on the options for disposal?
    a. Arsenic
    b. Polyfluoroalkyl substances
    c. Copper
    d. Trichloroethylene
    e. All of the above

5. Given the following information what is the average amount (pounds) of manganese removed in a year from a water treatment plant designed to remove manganese using greensand filtration?
    Average water treatment plant flow rate = 1.65 MGD
    Raw water manganese concentration = 0.95 mg/L
    Treated water manganese concentration = 0.02 mg/L
    a. 12.8
    b. 648
    c. 4,671
    d. 236,367

Solution:

Formula to use from ABC/WPI Formula-Conversion Sheet:
Loading Rate, lb/day = (Flow, MGD)X(Concentration, mg/L)X(8.34 lb/gal)
Where Flow = 1.65 MGD
Concentration is the amount of Mn removed which is (Mn concentration of the raw water) – (Mn concentration of the treated water) = 0.95 mg/L – 0.02 mg/L = 0.93 mg/L
Lb/day = (1.65 MGD)X(0.93mg/L)X(8.34 lb/gal) = 12.8 lb/day X 365 days/year
= 4,671 lb/year

Residuals Lagoon at the Salem and Beverly Water Treatment Plant. Photo courtesy of Bradley Perron Deputy Director, Salem and Beverly Water Supply Board.