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Engineered wetlands can be effective cold climate wastewater treatment

By Scott D.Wallace, P.E.

North America has not seen residential growth equal to that of the last decade since the end of the Second World War. At the same time, aging water and sewer infrastructure must be upgraded and replaced, leading to a number of redevelopment challenges. The creation of open space for recreation and wildlife habitat is often a top priority in creating livable, people-friendly communities. Successfully meeting these challenges requires combining the talents of a variety of professionals including engineers, landscape architects, planners, environmental scientists, and contractors.


British Petroleum wetland in Casper, Wyoming

The new challenges in land development (and redevelopment) are forcing everyone involved to be receptive to innovative approaches to infrastructure service. Engineered wetlands are playing a leading role in the new, green treatment infrastructure of the 21st century.

Types of wetland treatment systems

There are three major types of constructed wetlands: free water surface (surface flow, or open water), horizontal subsurface flow (vegetated submerged bed, root-zone or rock-reed filters), and vertical flow systems. Free water surface wetlands are man-made equivalents to natural marshes. These systems provide habitat for the most wildlife. Horizontal subsurface flow wetlands were developed in Germany in the 1960s. In these systems, water flows horizontally through a gravel bed planted with reeds. Because no water is exposed during the treatment process, these wetlands are ideal for residential sewage treatment. The newest types of wetlands are vertical flow processes; they provide the greatest amount of treatment within a given area and are ideal for situations where space is limited.

Cold climate wetland design and performance

Introduction of engineered wetland technology into Canada and northern areas of the United States has been limited by the ability of conventional wetland systems to operate without freezing during the winter. A new design approach is to use horizontal subsurface-flow and vertical-flow constructed wetlands that are covered with an insulating mulch layer to prevent freezing.

Properly designed insulation of the wetland bed is effective in preventing freezing and resulting hydraulic failure. Relying on snow and ice cover does not provide reliable insulation during cold periods with limited snow pack. Placing a mulch layer over the system allows the wetland to operate effectively throughout the winter months. The type of mulch insulation used can strongly affect the performance of the system. Only well decomposed organic materials can be used without degrading treatment efficiency. To be effective, insulation must be uniform in coverage, which requires that it be designed as an integral part of the wetland system.

Treatment in most wetland systems is limited by low oxygen transfer rates. Another advancement in engineered wetland technology has been the development of aerated wetland systems. (This technology, termed Forced Bed Aeration™ is patented in Canada and the U.S.) Aerated systems are not limited in their ability to transfer oxygen to the wastewater and as a result, are very effective in ammonia removal. Combining Forced Bed Aeration with insulation produces engineered wetlands that can work effectively year-round, even under very cold winter conditions.

Scott Wallace, P.E., is Executive Vice President, North American Wetland Engineering.
He is the principal author on the WERF design manual, "Feasibility, Design Criteria, and O&M Requirements for Small-Scale Constructed Wetland Wastewater Treatment Systems" scheduled for publication in 2005.
Contact: swallace@nawe-pa.com.

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