

## Methanol Use in Denitrification

### Why Do Some Wastewater Treatment Plants Need To Remove Nitrogen

Wastewater discharged from treatment facilities contains nutrients (nitrogen and phosphorus) and in certain regions of the country high levels of nutrients discharged into sensitive estuaries have resulted in hypoxic conditions. The hypoxic or low level dissolved oxygen has adversely affected aquatic life within the impacted estuaries such as Chesapeake Bay and Long Island Sound and these conditions requires the development and approval of Total Maximum Daily Loads or (TMDLs) by the state and federal regulatory agencies for nutrients. The TMDL process establishes waste load allocations for POTWs discharging into the watershed. In most impacted estuaries nitrogen is a nutrient of concern that has resulted in total nitrogen limits at wastewater treatment plants.

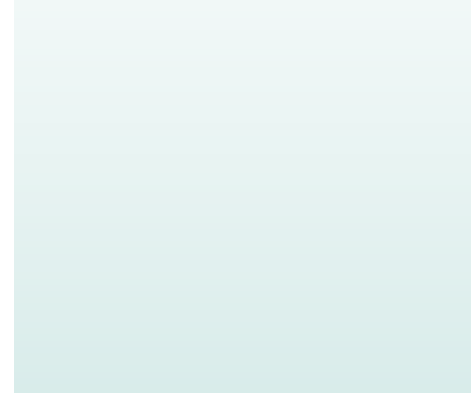
When low level nitrogen discharge limits of less than 8 mg/l total nitrogen are required at a wastewater treatment facility an external supplemental carbon source is sometimes needed as an electron donor to achieve consistent low level removal. It is typical that an external supplemental carbon source such as methanol is required in a post anoxic treatment process where a readily degradable carbon source needed for denitrification is not present in the wastewater in sufficient quantities.

#### Why is methanol used in the denitrification process?

Methanol historically has been the commonly used external supplemental carbon source for denitrification. Methanol use in both suspended growth (activated sludge) processes and biofilm (denitrification filter) processes has been well documented in the literature.

The high purity of the product combined with superior low COD:N chemical dosing requirements of methanol and low solids yield have made methanol the least costly of the readily available external supplemental carbon sources.

Methanol can be supplemented into most denitrification processes including the following: the pre-anoxic zone or the post-anoxic zone in a three or four



stage BNR configuration, dosed in the anoxic cycle in sequencing batch reactor (SBR) process, denitrification filters, utilized in the anoxic section of moving bed biofilm reactors (MBBR) and the anoxic zone in membrane filter (MBR) processes. Methanol is by recommended by all the major wastewater treatment process manufacturers for use as the external supplemental carbon source.

## Where is methanol being used for denitrification?

There are over 200 wastewater treatment plants using methanol in the United States. More than 110 POTWs on the east coast of the U.S. are currently using methanol or designed to use methanol for denitrification. These facilities are classified as NPDES major dischargers with a permitted discharge of over one million gallons per day discharging into the major watersheds. This represents over 2.1 billion gallons per day of permitted effluent flow with nitrogen removal processes in use.

The largest single methanol user in the United States with low level nitrogen limits is the Blue Plains Wastewater Treatment Facility that serves the greater Washington D.C. area with a permitted flow of 370 million gallons per day. The Blue Plains Wastewater Treatment Facility discharges into the Potomac River and is part of the Chesapeake Bay Watershed Total Maximum Daily Load (TMDL) for nutrients.

Methanol is the most commonly used external carbon source for denitrification in the United States and is almost exclusively used as the external carbon source of choice for denitrification filter processes.



## How much does methanol cost for denitrification?

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Methanol is typically the lowest cost external supplemental carbon source in both cost per gallon and cost per pound of nitrate removed.

In one wastewater utility in Pennsylvania they were able to reduce their annual methanol budget by 30% due to a reduction in methanol costs from 2014 to 2015. Methanol cost on a dollars per pound of nitrate removed are approximately 50% that of glycerol based supplemental carbon products.

Methanol has a low COD:N requirement of 4.5 and a high COD value of 1,185,000 mg/l. This results in a dosing requirement for denitrification of 3 mg methanol per mg nitrate nitrogen denitrified or 0.49 gallons of methanol per pound of nitrate nitrogen denitrified.

The low COD:N dosing requirements and low solids yield results in a superior low cost efficient external supplemental carbon source that generates the least amount of solids of commonly available carbon sources which results in the lowest cost to the wastewater treatment facility for operational chemicals.

## Additional Information on the use of Methanol for Wastewater Treatment

The Methanol Institute (MI) serves as the trade organization for the global methanol industry. Utility Managers, wastewater treatment plant operators, engineering firms and process equipment manufacturers interested in obtaining information on the use of methanol for denitrification can visit our web site at [www.methanol.org](http://www.methanol.org)

The Methanol Institute provides technical and safety information on the use of methanol in wastewater treatment applications including a safe handling manual.

