Candy Carbon®

For BNR

Denitrification and Phosphorus Reduction

What Is It?

Candy Carbon® is a product used by wastewater facilities to enhance biological processes, typically nutrient removal, to achieve discharge permit requirements. External organic carbon can range from Candy Carbon® to methanol. Some currently used formulations have both positive and negative aspects. Methanol is widely used but is hazardous because it is flammable. Other products may be synthetic chemicals that can cause plant upsets. Please note that external organic carbon is not inorganic carbon (alkalinity), which is required and consumed during the wastewater nitrification process (conversion of ammonia to nitrate).

Uses:

Candy Carbon® has been used in wastewater applications for:

Enhancing denitrification processes

Enhancing phosphorus uptake (enhancing biological phosphorus removal/uptake)

Balancing F:M ratios (food to microbe or biomass [MLSS])

Where else may Candy Carbon® be needed?

Candy Carbon® may be used in any wastewater stream (industrial, municipal, or animal) that needs additional BOD/COD, volatile fatty acid (VFA) production, or organic carbon to achieve permit requirements.

It may also be used in any wastewater stream that needs more food due to specific processes, low influent BOD/COD, seasonal use (resorts, septic systems, etc.), or temporarily overdesigned facilities where anticipated inputs have not yet been developed.

Some currently used products are:

Candy Carbon®	Methanol
Molasses	Return Activated Sludge (RAS)

Micro C™	Sugar
Dog or Pig Food	Beer Waste
Acetic Acid	Raw Sewage

The above products have high COD/BOD and may be biologically accessible organic carbon materials.

Where: **Denitrification** - Organic carbon is required by denitrifying bacteria under anoxic conditions to convert nitrate (NO3) to nitrite (NO2) and then to nitrogen gas (N2). Most engineering designs state that 1.90 grams of methanol or 2.86 grams of COD are required to convert 1 gram of NO3-N to N2 gas. Our experience with Candy Carbon® indicates that significantly less product is needed to accomplish the same thing. Investigations are underway, but there is currently no explanation for this. Studies conducted at small, medium, and large facilities show that it works very well.

One important aspect of the denitrification process is that the denitrification zone must be truly anoxic (no free oxygen). If free oxygen is present, the facultative denitrifying bacteria will use this more readily available oxygen source rather than consume oxygen from the nitrate and nitrite molecules. It is a waste of money to feed any form of organic carbon to achieve denitrification if the denitrification zone is not anoxic. Anoxic conditions are best measured with an oxidation-reduction potential (ORP) meter and usually fall in the range of -100 to +100 mV.

Where: **Biological Phosphorus Removal, aka "BioP"** - In this process, volatile fatty acids (VFAs), a specific type of organic carbon, are required to "feed" phosphorus-accumulating organisms (PAOs) in the anaerobic zone of the treatment plant (no free oxygen or combined oxygen in the form of nitrate, nitrite, sulfate, carbon dioxide, etc.). When PAOs have VFAs to feed on, they release phosphorus. When these phosphorus-depleted organisms move into the aerated zone of the plant, they take up (eat, accumulate, consume, or "gobble up") phosphorus, a process commonly known as luxury phosphorus uptake. These phosphorus-engorged bacteria settle out in the clarifier and are removed, along with the phosphorus they consumed, in the waste activated sludge (WAS). Facilities should be careful about how this sludge is handled because phosphorus can be released if conditions become anaerobic. Water returned to the head of the treatment plant from sludge dewatering processes could contain high amounts of phosphorus if the sludge becomes anaerobic.

Where: **Improve the food-to-biomass ratio (F:M)** - When a wastewater treatment plant has an F:M (food-to-microbe) ratio that is too low (facility-specific), additional food (organic carbon) is needed to keep the activated sludge (living biomass of waste-eating organisms) alive. When influent BOD/COD (a measurement of the amount of organic carbon entering the wastewater treatment plant) is too low, the biomass begins to die. Dying activated sludge does not settle well and could lead to TSS effluent violations. Dead sludge cannot effectively treat waste material when normal loading resumes. Influent BOD may drop for several reasons, including an intermittent service-area population (resort areas), high seasonal or permanent infiltration and inflow (I&I;), or a wastewater treatment facility that is overdesigned for the current population or use. During these periods of low BOD (food) input, the influent can be supplemented with external carbon to keep the biomass alive and ready to digest waste when influent BOD returns to normal design ranges.

Application rates for Candy Carbon® will vary based on the client's desired results, type of waste stream (industrial or municipal), flow rate, and contact time.

If you are considering the use of an external carbon source, there are a few things to consider:

Availability - Will the product be available in the quantities you need at the right time?

Beer waste, waste solids, and commodities such as sugar and molasses may be in short supply.

Hazards - Are there challenges associated with products that are explosive or corrosive?

Methanol - Flammable and may require secondary containment (explosion-proof).

Acetic acid - May be corrosive and require secondary containment.

Special handling - Some products require special handling and storage.

Candy Carbon® has been proven to be a cost-effective means of achieving desired results. Contact BioLynceus directly today to receive recommended protocols for your specific project.

For additional information, contact Herb Fancher at herb@biolynceus.com or Rick Allen at rick@biolynceus.com, or call 303.888.2008.