

## Algae's Influence on the BOD<sub>5</sub> Test

Steve Harris, President, H & S Environmental, LLC

Algae...you both love it and hate it. You love algae because they add dissolved oxygen to your system through photosynthesis. This leads to BOD removal, better ammonia removal, pathogen kill, and odor control. This is the upside of having algae in your pond system.

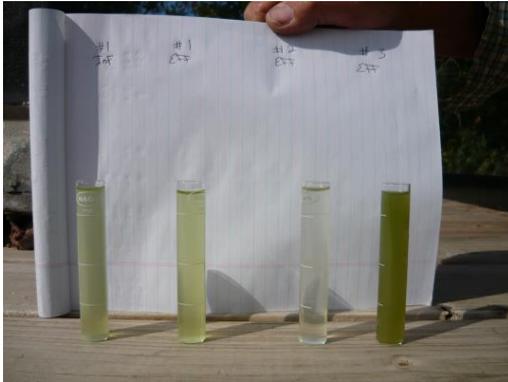


Figure 2. Algae Concentrations Vary from One Cell to Another. This Will Change Water Quality Photo Courtesy of Mark Court, Wyoming Rural Water

You hate it because algae create TSS and BOD violations as well pH problems. TSS violations caused by algae are well understood, but algae's contribution to BOD violations requires explanation.

When the lights are on algae create oxygen. When lights are off algae no longer create oxygen, but



Figure 1. TSS Filter. Effluent TSS 105 mg/l

consume it in a process called respiration. This is why measuring dissolved oxygen before sunrise is so important. For twelve (12) hours or so algae have been consuming oxygen at night under dark conditions instead of producing it. The bacteria and protozoa in the system consume oxygen 24/7, algae 12 hrs. When the sunlight returns algae begin once again to make oxygen to add to the water column.



Figure 3. Effluent from Each Cell in the System and the Chlorine Contact Chamber

Imagine dark conditions over your lagoon for five (5) consecutive days! What would happen to your DO? Now think about what happens to your effluent sample during the BOD<sub>5</sub> test. Under the darkened conditions of the BOD<sub>5</sub> test, algae consume oxygen for five (5) days instead of producing it. Along with bacteria, dead and decaying algae cells can also add directly to BOD in the test bottle by releasing the material that was once bound up in their cells.

To determine algae's influence on the BOD<sub>5</sub> test, algae are filtered out of one of the samples in a split sample. The BOD test is run on both samples of the same sample and the two are compared. The results can be

dramatic. The following certificate shows a worst-case scenario from a lagoon system in a rural community...a system probably much like your own.



# Algae's Influence on the BOD<sub>5</sub> Test

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**A6I2745**  
 General Chemistry  
 BOD Reduction

## Certificate of Analysis

Sample ID: A6I2745-01  
 Sampled By: [REDACTED]  
 Sample Description: Headworks

Sample Date - Time: 09/22/16 - 13:00  
 Matrix: Waste Water  
 Sample Type: Grab

### BSK Associates Fresno General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Biochemical Oxygen Demand	SM 5210B	300	50	mg/L	50	A613004	09/23/16 16:33	09/28/16	

Sample ID: A6I2745-02  
 Sampled By: [REDACTED]  
 Sample Description: Pond 1 in

**300 mg/L**

Sample Date - Time: 09/22/16 - 13:03  
 Matrix: Waste Water  
 Sample Type: Grab

### BSK Associates Fresno General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Biochemical Oxygen Demand	SM 5210B	63	15	mg/L	15	A613004	09/23/16 16:35	09/28/16	

Sample ID: A6I2745-03  
 Sampled By: [REDACTED]  
 Sample Description: Pond 1 out

**63 mg/L**

Sample Date - Time: 09/22/16 - 13:05  
 Matrix: Waste Water  
 Sample Type: Grab

### BSK Associates Fresno General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Biochemical Oxygen Demand	SM 5210B	54	10	mg/L	10	A613004	09/23/16 16:37	09/28/16	

Sample ID: A6I2745-04  
 Sampled By: [REDACTED]  
 Sample Description: Pond 2 out

**54 mg/L**

Sample Date - Time: 09/22/16 - 13:10  
 Matrix: Waste Water  
 Sample Type: Grab

### BSK Associates Fresno General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Biochemical Oxygen Demand	SM 5210B	130	30	mg/L	30	A613004	09/23/16 16:39	09/28/16	

Sample ID: A6I2745-05  
 Sampled By: [REDACTED]  
 Sample Description: Pond 3 Discharge

**130 mg/L**

Sample Date - Time: 09/22/16 - 13:15  
 Matrix: Waste Water  
 Sample Type: Grab

### BSK Associates Fresno General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Biochemical Oxygen Demand	SM 5210B	100	15	mg/L	15	A613004	09/23/16 16:41	09/28/16	

Sample ID: A6I2745-06  
 Sampled By: [REDACTED]  
 Sample Description: Pond 3 Discharge

**100 mg/L**

Sample Date - Time: 09/22/16 - 13:15  
 Matrix: Waste Water  
 Sample Type: Grab

### BSK Associates Fresno General Chemistry

Analyte	Method	Result	RL	Units	RL Mult	Batch	Prepared	Analyzed	Qual
Biochemical Oxygen Demand - Dissolved (T)	SM 5210B	6.8	4.0	mg/L	4	A613004	09/23/16 16:43	09/28/16	

**6 mg/L**



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In this system, on this day, a full 94 mg/l of BOD was caused by the presence of algae in the effluent of this lagoon system. The Dissolved Biological Oxygen Demand (filtered BOD) is the BOD without the algae present. This system had to report effluent BOD of 100 mg/l on their DMR.

So, what does this mean for all of us operating lagoon systems? Discharge as few algae cells as possible! This can successfully be accomplished by 1) discharging your effluent from a few feet below the surface of your pond's surface or 2) using a sand filter. The newest EPA lagoon manual (EPA/600/R-11/088 | August 2011 | [www.epa.gov/nrmrl](http://www.epa.gov/nrmrl)) shows just how successful sand filters can be at lowering not only TSS but BOD as well. (See Chapter 7)

Sand filters of all types have proven themselves effective at polishing wastewater pond system effluents to very low levels of BOD and TSS. Serious consideration should be given by any lagoon system faced with building an activated sludge plant, to polishing their lagoon effluent using some sort of sand filtration. This alternative will allow you to keep your lagoon system while minimizing upgrade costs to maintain permit compliance.



*Figure 4. Algae and sludge Can Both Leave the Pond System to Affect BOD*



Because algae need sunlight, their concentrations are typically highest in the upper three (3) feet of a pond's surface. Pulling water from below this "photic zone" helps to minimize the discharge of algae cells.

In deeper treatment cells this is a smart upgrade.

*Figure 5. Pulling the Water Below Three (3) Feet Will Generally Result in Fewer Algae Cells Being Discharged*