

CONFIDENTIAL



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# MOLEAER<sup>®</sup>

## ADVANCING NANOBUBBLE TECHNOLOGY

### WATER & WASTEWATER TREATMENT



# Case Study: Industrial Wastewater Management

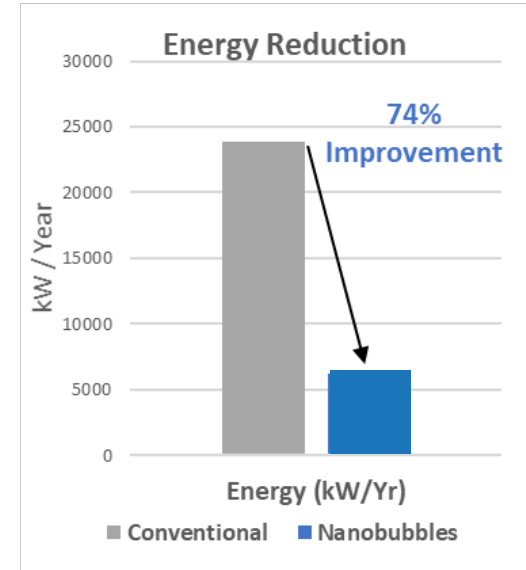
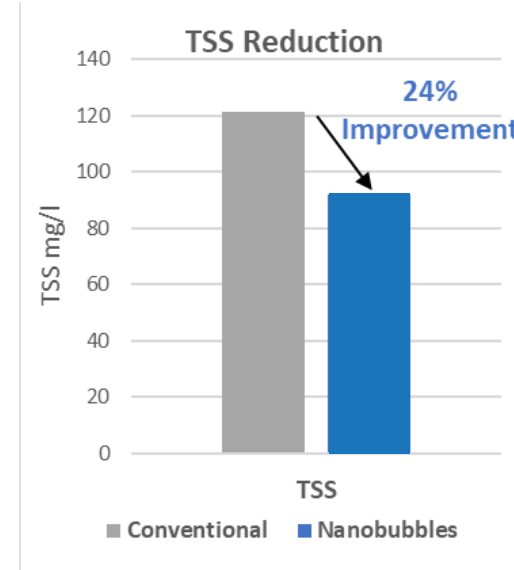
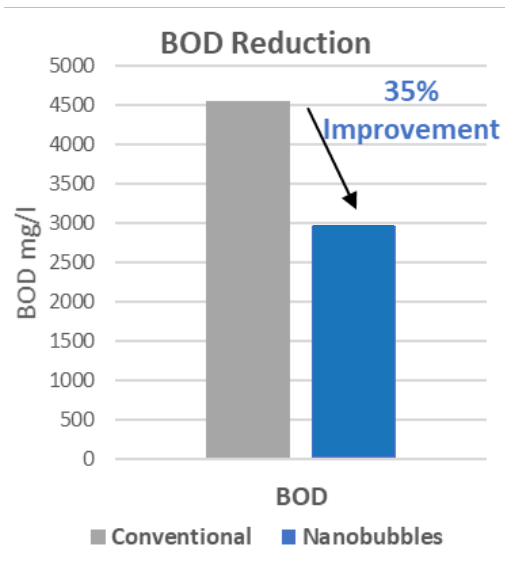
**Location:** Hershey Ice  
Cream Company

**Purpose:** Dissolved Air  
Flotation



## Key Findings

- BOD reduction – 35% improvement
- TSS reduction – 24% improvement
- Energy reduction – 74% improvement



# Case Study: Industrial Wastewater Management

**Location:** Bear Republic  
Brewery

**Purpose:** Improve  
sustainability, efficiency and  
capacity of existing  
Membrane Bio-Reactor  
(MBR) system

## Background

### Problem

- Under oxygenation of MBR
- Nocardia foaming, overloading and membrane fouling

### Solution Details

- Moleaer initially augmented their existing aeration system with one XTB 200 Nanobubble Generator
- Bear Republic Brewing later added a second XTB 200
- Original (3) 20 HP Blowers were later replaced with (1) 15 HP Blower



# Case Study: Industrial Wastewater Management

**Location:** Bear Republic  
Brewery

**Purpose:** Improve  
sustainability, efficiency and  
capacity of existing  
Membrane Bio-Reactor  
(MBR) system

**“We had all the issues that go with under-oxygenated MBR: nocardia growth, and foaming, and poor treatment, and blinding of the membranes and all that. When I did the rate of return for the system, we basically ended up saving \$36,000 per year for OpEx.” – Bear Republic Brewery**

## Key Findings

### Improve Energy Efficiency & Process Reliability

- Reduce oxygen requirements by 33%
- Improve dewaterability & reduce polymer usage by 33%
- Improve MBR process stability and reliability
- Eliminate filamentous bacteria foaming issues
- Eliminate use of chemical defoamer

### Increase Treatment Capacity

- Increase treatment capacity by >60%
  - Treat primary sludge in MBR
- Increase Average MLSS by 70% to 12,000 mg/L

### Return on Investment

- Customers recognized annual savings, ROI of just over 1 year



# Case Study: Surfactant Removal in Wastewater

**Location:** Fallbrook, CA  
Municipal Wastewater  
Treatment Facility

**Purpose:** Surfactant  
removal



## Background

### Plant Specifications:

- Facility permitted flow rate: 2.7 MGD
- Flow rate during time of testing: 1.3 – 1.5 MGD
- FPUD provides municipal wastewater treatment services to a population of approximately 25,000 (primarily residential and commercial wastewater)

### Equipment Specifications:

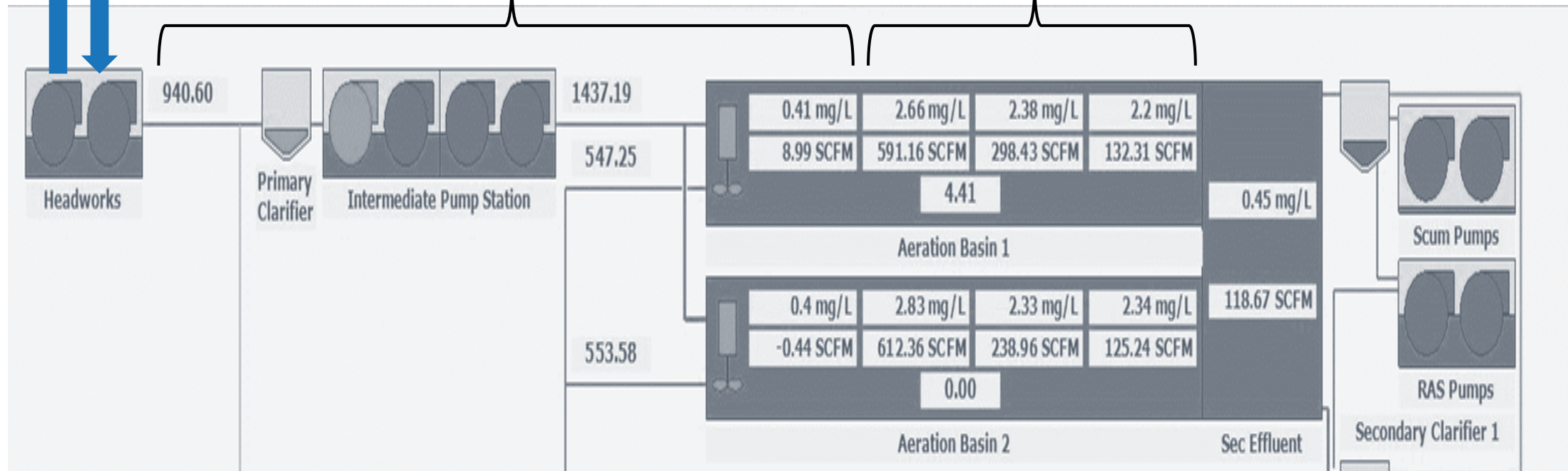
- Liquid flow rate: 1800-1900 gpm
- Air flow rate: 60-100 scfh
- Mass of NBs depends on tank volume and flow rate: In this case, # of cycles =  $1.7 \pm 0.3$

# Case Study: Surfactant Removal in Wastewater

**Moleaer  
Nanobubbles  
Injection Point**

**Nanobubbles react with  
surfactants in the wastewater  
prior to aeration**

**Nanobubbles react with  
biomass in the wastewater  
improving oxygen transfer  
efficiency and oxygen uptake  
rate of the biomass**

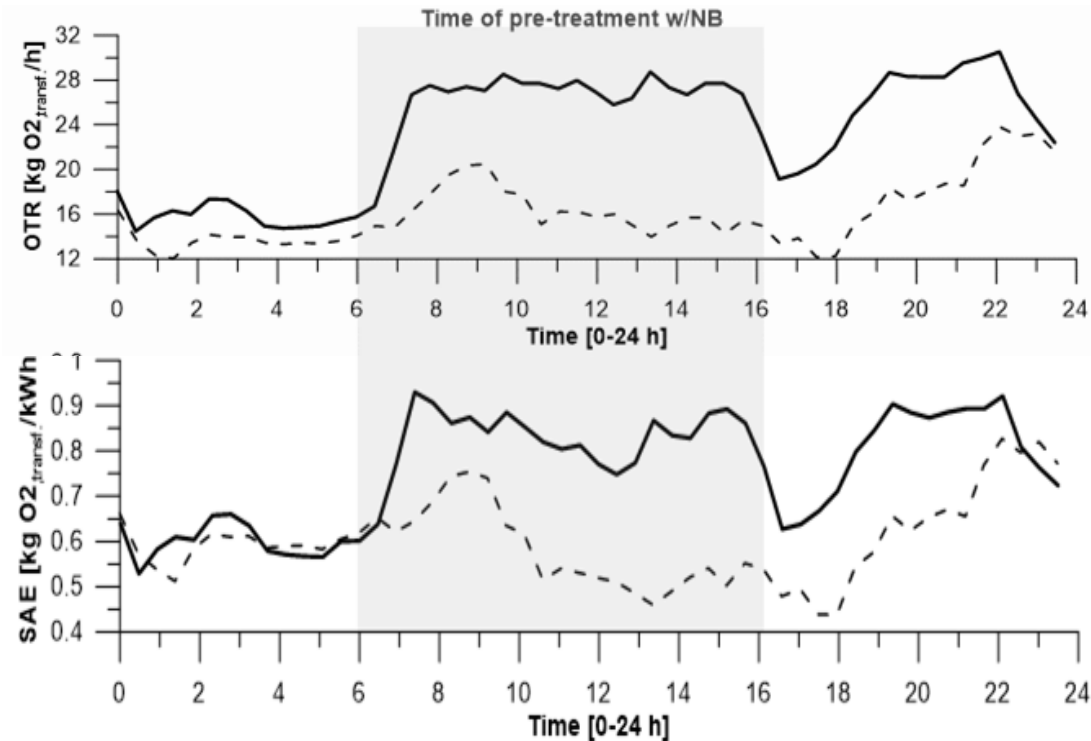


## Case Study: Surfactant Removal in Wastewater

**Location:** Fallbrook, CA  
Municipal Wastewater  
Treatment Facility

**Purpose:** Surfactant  
removal

- 60% more oxygen was transferred with the existing aeration system (on avg)
- Existing aeration system was 45% more energy efficient (on avg)

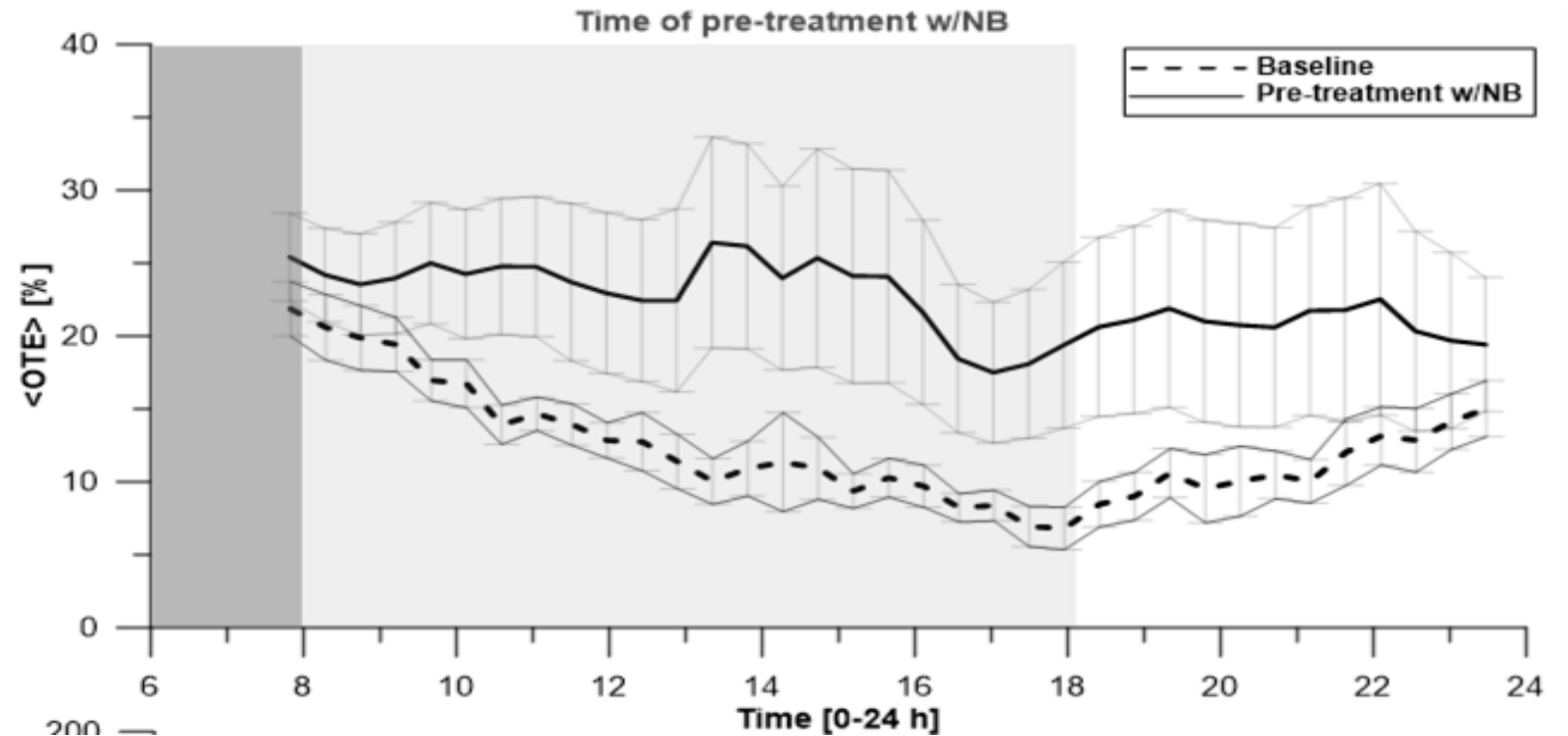


## Case Study: Surfactant Removal in Wastewater

**Location:** Fallbrook, CA  
Municipal Wastewater  
Treatment Facility

**Purpose:** Surfactant  
removal

- Average OTE was significantly higher with nanobubble pre-treatment





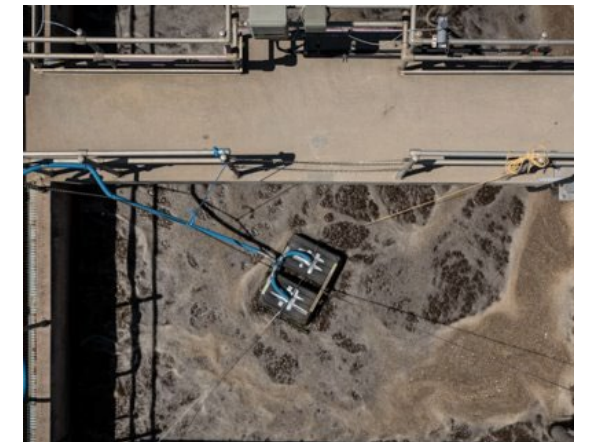
# Case Study: Surfactant Removal in Wastewater

**Location:** Fallbrook, CA  
Municipal Wastewater  
Treatment Facility

**Purpose:** Surfactant  
removal

## Key Findings

- Reduced organic load to secondary process
- Increased quaternary ammonia compounds removal by >20%
- Increased secondary process aeration efficiency by 45%
- Increased oxygen transfer rate by 61%
- Improved biomass kinetics by 25%
- Increased nitrification rate by 22%
- Increased secondary treatment capacity of 25%



# Case Study: Surfactant Removal in Wastewater

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- Savings realized by pre-treatment with nanobubbles
- Additional savings achieved if nanobubble generation can be integrated into existing pumping system
- Further value can be achieved with additional biogas production
- Payback achievable within 2 years

# Case Study: Industrial Wastewater Treatment

**Location:** Industrial Meat  
Processing Plant

**Purpose:** Improve  
performance of wastewater  
treatment

## Background

- WWTP was overloaded
- Oxygen transfer efficiency was very low
- DO level could not be maintained in the aeration basin (0.0-0.15 mg/L)
- System consisted of:
  - DAF Pretreatment
  - Anoxic Basin
  - Aerobic Basin – 5.5 Million Gallons
  - Final Clarifier
- Flow Rate of 3.2 MGD
  - BOD
  - TN
  - Ammonia

## Solution Specifications

- A diesel-based Gorman Rupp pump with a 6-inch NBG generation system was deployed
- Pump ran at 1500 GPM
- Air was supplied by an onboard compressor producing 5 SCFM

## Case Study: Industrial Wastewater Treatment

**Location:** Industrial Meat Processing Plant

**Purpose:** Improve performance of wastewater treatment

A mobile 2000 gpm Optimus Nanobubble generator was deployed to temporarily increase treatment capacity. Air nanobubbles were injected into a wastewater lagoon to improve the aeration efficiency and ammonia removal through enhanced nitrification.



### Key Findings:

- Increased Oxygen Transfer  
Efficiency of existing aeration system by 40%
- Reduced Ammonia from 1.6 to 0.6 mg/L
- Additional power to support NBG significantly lower than additional blower alternative.

# Case Study: Municipal Wastewater

**Location:** Village of  
Warrens Municipal  
Wastewater Treatment Plant

**Purpose:** Increasing  
treatment capacity and  
lowering the cost to treat

## Background:

- The treatment facility unable to supply enough oxygen into the oxidation ditches
- Became overwhelmed and could not raise the oxygen levels above 0 ppm in any of the ditches, resulting in improper treatment for over a month

## Key Finding:

- Dramatically increased DO levels across ditches



## Dissolved Oxygen Levels

	Before 200 XT-B Installation	After 200 XT-B Installation
Outer Ditch	0.11 ppm	3.6 ppm
Middle Ditch	1.2 ppm	7 ppm
Center Ditch	4 ppm	10 ppm

# Pistachio Processing Wastewater Treatment

**Purpose:** Treat wastewater from pistachio processing to reuse for irrigating crops

## Specifications:

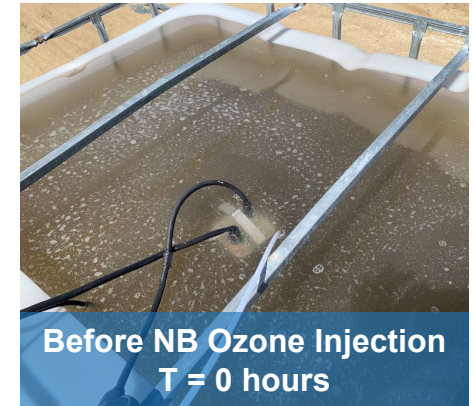
- Sentinel 5
- 6 SCFH gas flow rate
- 3 grams/hr @ 1% wt ozone injection

## Key Findings

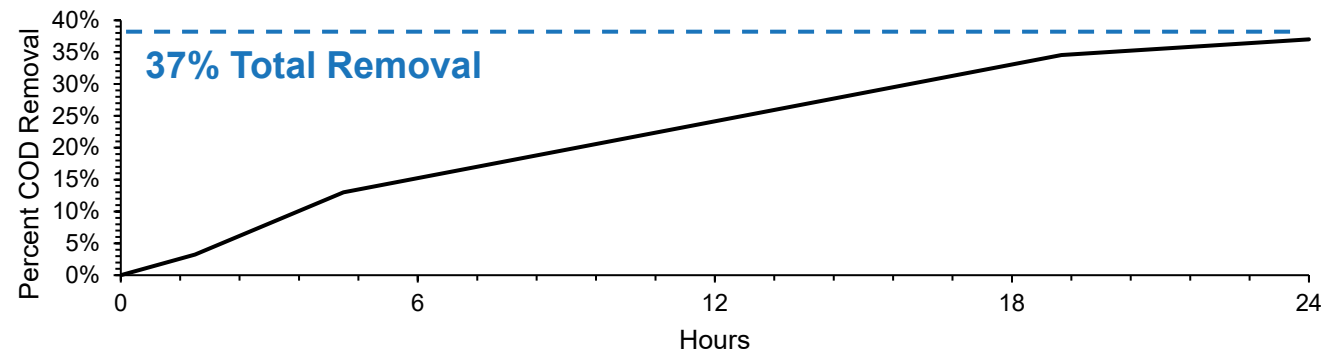
- 63% reduction in turbidity
- 35 ppm increase in dissolved oxygen
- 580 mV increase in ORP
- 99% reduction in E. coli
- 77% reduction in Coliform

## ESG Impact

- Potential ~0.56 kg CO<sub>2</sub>eq / kg K<sub>2</sub>O credit for recovery and reuse
- 37% COD reduction suggests a potential reduction of 646.8 lbs (294 kg) of CH<sub>4</sub> per 24 hours



## Chemical Oxygen Demand Removal



# Pistachio Processing Wastewater Treatment

**Location:** Central California

**Purpose:** Treat wastewater from pistachio processing to reuse for irrigating pomegranate orchard

## Specifications:

- Titan NBG
- Influent flow rate: 6,100 gpm

- 30.6% reduction in BOD, organic loading (equal to 16,352 lbs per day)
- 13.4% reduction in Total Nitrogen (TKN) (equal to 1,050 lbs per day)
- 16.5% reduction in Total Suspended Solids (TSS)
- 40% reduction in Total Fixed Solids
- 25% reduction in potassium



Description	Value	Unit
Average Influent BOD	3,775	mg/L
Average Daily Flow	1,700,000	Gallons/day
Total Daily BOD Load	53,439 (24,290)	lbs per day (kg/day)
Total Monthly BOD Load	1,629,875 (740,852)	lbs per year (kg/year)
Percentage Reduction in Loading by Oxygen Nanobubbles	30.6	% of BOD Removal
Margin for Increase Treatment Capacity	520,200	Gallons/day
	16,352	lbs/day
	498,742	lbs/month

# Juice Processing Wastewater Treatment

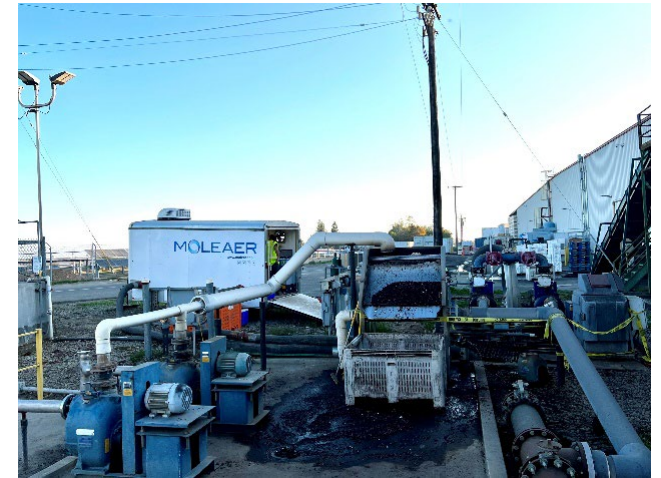
**Location:** California juice processing facility

**Purpose:** Pretreat and improve influent wastewater treatment

**Specifications:**

- Titan NBG
- 6-million-gallon primary aeration lagoon and 3 secondary treatment lagoons

- 74% increase in dissolved oxygen
- 52% increase in ORP
- 44% reduction in QAC
- 28% increase in surface tension
- 23% reduction in influent COD
  - Increased in total treatment capacity by 138,000 gallons or 6,320 lbs of COD per day
  - Treatment capacity of activated sludge process will be increased by 20-25% due to the combined effect of COD reduction, QAC reduction and increased oxygen transfer efficiency



Description	Value	Unit
Average Influent COD	5,500	mg/L
Average Daily Flow	600,000	Gallons/day
Total Daily COD Load	27,479 (12,491)	lbs per day (kg/day)
Total Monthly COD Load	10,029,872 (4,559)	lbs per year (mt/year)
Percentage Reduction in Loading by Oxygen Nanobubbles	23	% of COD Removal
Margin for Increase Treatment Capacity	138,000	Gallons/day
	6,320	lbs/day
	2,306,870	lbs/month



**Thank You!**

**MOLEAER<sup>®</sup>**  
ADVANCING NANOBUBBLE TECHNOLOGY

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# Advancing Nanobubble Technology

Moleaer™ is the global leader in manufacturing industrial-scale nanobubble systems that deliver extraordinary improvements in sustainable food production, chemical-free water treatment, and the recovery of natural resources.



## FOOD

Horticulture | Specialty Crops | Aquaculture | Food Safety

### >500 Systems

- Increasing crop yields by up to 56%
- Reducing oxygen costs in salmon farms by 70%
- Demonstrated that O<sub>2</sub> NBs can replace chlorine for food sanitization

## WATER

Algae Control | Advance Oxidation | Biological Treatment | Flootation

### >400 Systems

- Reduced the overreliance on chemical pesticides in >100 water bodies
- Reduced energy consumption >75% in industrial wastewater processes
- Potential to reduce energy consumption in municipal wastewater by 31% = 2.5M tons of CO<sub>2</sub>

## NATURAL RESOURCES

Produced Water Treatment | Heap Leaching | EOR | Flootation

### >75 Systems

- Reduced the cost of recycling produced water
- Increased oil production from aging wells by 50%-90%
- Demonstrated >14% increase in gold recovery

## Our Belief

**We believe in protecting and improving the health of our community and ecosystems.**



**Water is essential to all life and one of our most precious resources**

**Our water is experiencing a man-made crisis**

- Nutrient, chemical, pollution and toxin loading
- Warming temperatures due to climate change
- Increasing dependence on harsh and toxic chemicals

**This causes problems for all life, including:**

- Unsafe drinking water
- Harmful algae blooms (HABs) linked to health crises and carbon emissions
- Crop death and food insecurity due to increased pathogens and harmful bacteria and biofilms
- Fish kills and unhealthy fish that affect the entire food web
- Foodborne illnesses like E. coli that cause hundreds of thousands of illnesses and even deaths

**Our nanobubble technology is a chemical-free solution that helps solve these urgent problems and efficiently improves water quality in many industries.**

## Our Impact

Moleaer improves the health of people and the planet.



- **Help grow more food almost anywhere while reducing energy costs, eliminating disease and saving water**
- **Make aquaculture more sustainable and reduce its environmental impact**
- **Restore the health of entire aquatic ecosystems without the use of chemicals**
- **Improve drinking water quality without chemicals**
- **Reduce effects of contaminated runoff into fresh water supplies and the ocean**