WASTEWATER TREATMENT

MICROBE-LIFT® bio-technology products are the most preferred bacterial products for improving wastewater treatment processes. With unparalleled capabilities to breakdown waste, reduce toxic and corrosive gases, and significantly reduce sludge. Wastewater operators and managers experience superior results from the efficiencies and related improvement in system stabilities regarding the reduction of COD, BOD, TSS, & Fats-Oils-Grease (FOG). Elimination of odor associated with the generation of hydrogen sulfide and ammonia is a significant benefit when using MICROBE-LIFT®. MICROBE-LIFT® is also effective in-situ for the remediation of pollution caused by hydrocarbons. Proven economic benefits have been experienced via the utilization of MICROBE-LIFT® technology and it's abilities to reduce the cost of sludge handling, while improving system maintenance by reducing hydrogen sulfide, and other corrosives. MICROBE-LIFT® significantly reduces costs, increases operational efficiency, and assists in the achievement of regulatory compliance.

The unique consortium of microbes in MICROBE-LIFT® combine with indigenous populations to provide a bio-system that enhances the natural elemental cycles responsible for processing wastewater in a wide variety of systems. MICROBE-LIFT® enhances biomass efficiency and stability in wastewater treatment systems with bio-technology designed to breakdown, oxidize and remove difficult to degrade waste.

With over 40 years of experience, MICROBE-LIFT® is manufactured in the U.S. by **Ecological Laboratories**, Cape Coral, Florida.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.
www.EcologicalLabs.com

CS13000

Made in the USA

13100 MUNICIPAL WASTEWATER CASE STUDIES

13101	MICROBE-LIFT® Technology Reduces BOD, COD, and TSS and Helps Lower H_2S at Kibbutz in Israel
13103	Bioaugmentation with MICROBE-LIFT® Technology Remediates Polluted Drainage Retention Pond in Penang, Malaysia
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13107	Well-Operated Municipal Plant Achieves $130,000 Cost Savings from MICROBE-LIFT® Technology in Deutsch-Wagram, Austria
13108	Municipal Lagoon Treatment Efficacy Was Restored in LaCosta, Uruguay with MICROBE-LIFT® Technology
13109	An Average Reduction in Sludge of Approximately 20% Was Observed at Zutphen Plant in the Netherlands
13110	MICROBE-LIFT® Technology Improves Efficiency of Anaerobic Digesters in Columbia - Preventing Costly Expansion
13111	Bioaugmentation Reduces Sludge Production 20% Allowing Digester to Handle Increased Load in Hod Hasharon, Israel
13113	Bioaugmentation Remediates Heavy Organic Loading in Municipal Oxidation Pond in Drakenstein, South Africa
13114	California City Reduces Lift Station Maintenance with MICROBE-LIFT® Technology
13115	Pusan, Korea Achieve 20% Sludge Reduction Allowing Digester to Handle Increased Loading
13116	Shoal Lake Lagoon Treatment with MICROBE-LIFT® Technology Ensures Rapid Start-up in Spring
13117	MICROBE-LIFT® Technology Speeds Compost Processing & Reduces Odor While Producing Higher Quality Compost
13118	Odor & Solids Reduction at Waste Water Treatment Plant on Resort Island in Southeast Georgia
13119	Sludge Reduction & Cost Savings at Sequential Batch Reactor Plant in Southern Pennsylvania

The case study results listed above were achieved with MICROBE-LIFT® Technology and products, formulated and manufactured by Ecological Laboratories Inc., with technical support for administering the products provided by Ecological Laboratories Inc., in support of their worldwide representatives.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.
www.EcologicalLabs.com

CS13100

MICROBE-LIFT® Technology Reduces BOD, COD, and TSS and Helps Lower H_2S at Kibbutz

Location: **Kibbutz Yagur, Haifa, Israel**

Background: A field study was conducted in cooperation with Dr. R. Armon and Dr. F. Orshansky at the Center of Research in Environmental Engineering in Technion, Haifa 3200, Israel February 23 to May 17, 1994.

Kibbutz Yagur has a population of approximately 1400 people who live in a communal settlement. The kibbutz has several mid-size industries including an aluminum can factory and produces many agricultural crops including cotton and corn. The kibbutz grows cows for dairy products. The cow manure is digested anaerobically. Human and farm wastes are both transferred to three ponds for treatment. The first pond is an anaerobic sediment pond. The final water is used for agricultural irrigation. The data on each pond is illustrated in the diagram below:

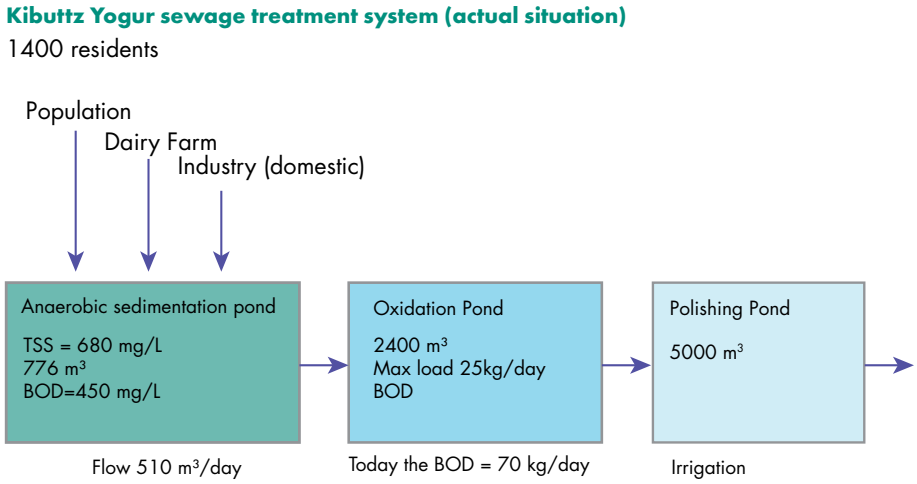

Fig. 1: *Schematic of Kibbutz Yagur's treatment system. Hydraulic retention time in the oxidation pond runs 5.2 days in summer and 2.6 days in winter.*

Objective: During hot weather the anaerobic digester and sometimes the oxidation pond emit foul odors as a result of anaerobic fermentation. The oxidation pond was chosen for the study because it had an intermediate load and the goal was to utilize MICROBE-LIFT® to improve degradation of BOD, COD, TSS, and H_2S.

To establish control parameters, the oxidation pond effluent was tested for two months prior to the application of product. Analyses were performed according to Standard Methods Manual (1992).

The dosage schedule included an initial 15-gallon purge on April 5th followed by 1.5 gallons per week for four weeks. Thereafter, for an additional three weeks, there was no further addition of product.

Made in the USA

Results Achieved: Drs. Armon and Orshansky concluded that MICROBE-LIFT® technology met the product goals. It reduces BOD, COD, TSS and, to some extent, H_2S. They believed that all parameters indicated that the dosage should have been maintained at a higher level to achieve optimal results based on the high organic loading and short retention time. They suggested that in each application the optimal dosage should be determined, or at least adjusted, experimentally.

However, in accordance with observations above, and depicted in the following graphs, they stated that they "were able to recommend MICROBE-LIFT® as a product intended to improve water and wastewater quality."

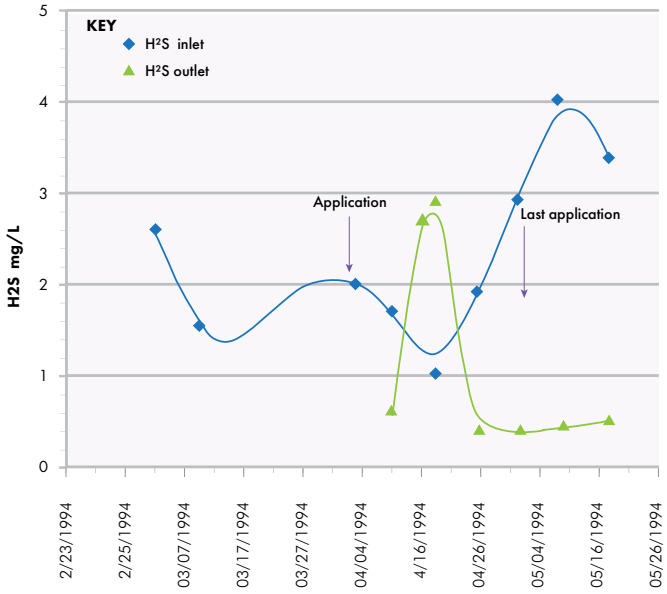

Fig.1: *H^2S data before and after product application.*

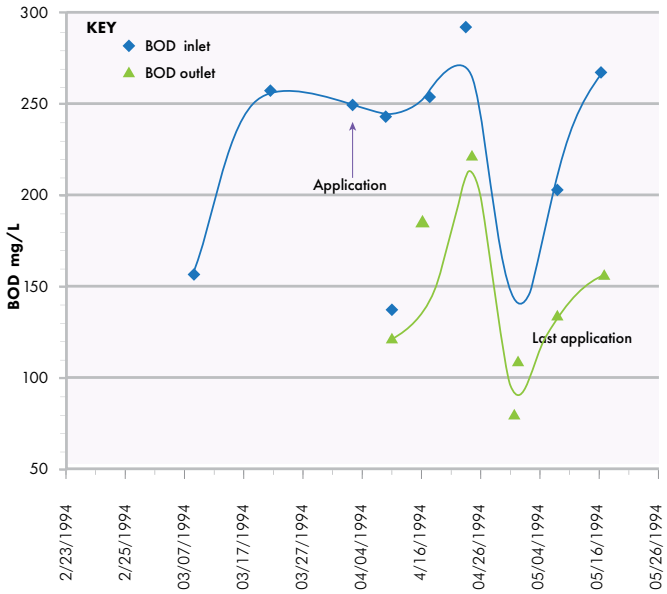

Fig. 2: *BOD results inlet versus outlet prior, during, and after product application.*

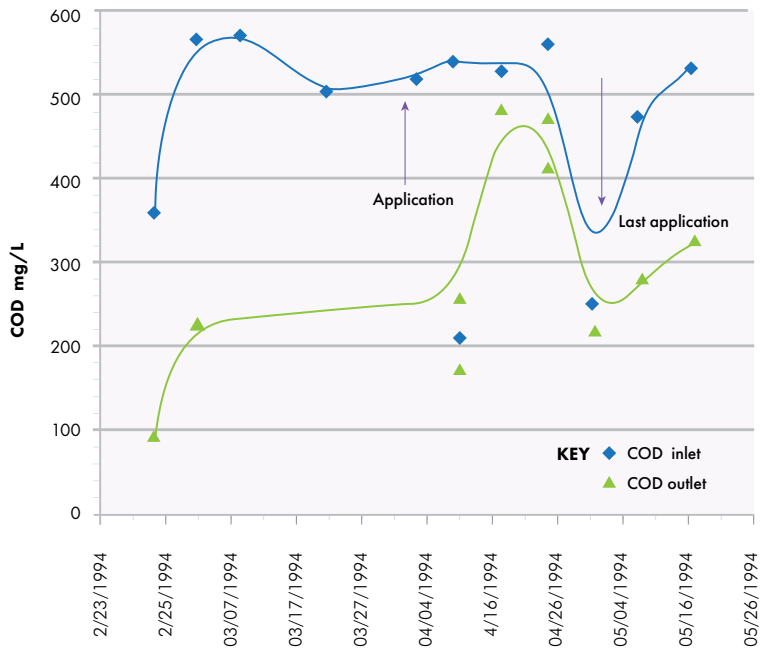

Fig. 3: *COD results prior, during, and after product application.*

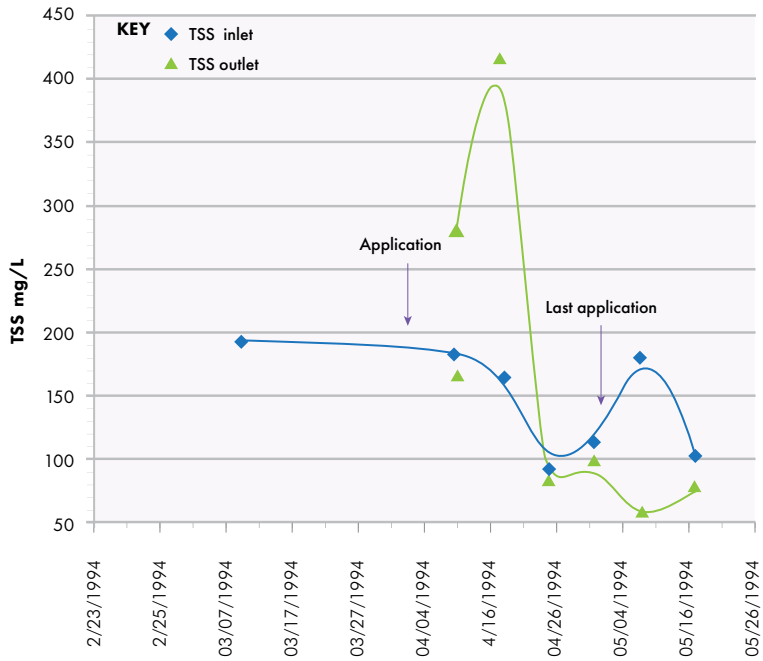

Fig. 4: *TSS results of influent and effluent prior, during, and after the trial.*

For more information on MICROBE-LIFT® Technology contact

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CS13101

Bioaugmentation with MICROBE-LIFT® Technology Remediates Polluted Drainage Retention Pond in Penang, Malaysia

Location: **Penang, Malaysia**

Background: S-10 is a flood mitigation river water holding pond in Penang, Malaysia. Drain water from Georgetown is channeled into this 150M x 85m x 2m deep retention pond before being discharged into the sea. Excess water in the pond is either drained into the sea during low tide by opening the tidal gate or through mechanical pumping when sea level is higher than the pond water level. The retention pond prevents ingress of salty seawater into Georgetown and allows free flow of surface drain water during heavy rain that coincides with high sea water level.

Fig. 1: *Picture of S10 flood mitigation holding pond in Penang.*

Fig. 2 *Additional pictures of the pond and drainage system*

Fig. 2 & 3: *Additional pictures of the pond and drainage system.*

This drainage allows discharge of both ground surface water during heavy rain and discharge of wastewater including domestic sewerage and wastewater from commercial and industrial operations. Discharge of untreated grey water forms the bulk of the water flowing into the pond on dry days. The influent water pollution level is significantly diluted during heavy rain. Influent BOD ranges from 40 mg/l to 250 mg/l and COD has a low value of 100 mg/l to as high as nearly 1,000 mg/l. The influent water also carries a very high concentration of suspended solids and floating debris. Most of the floating debris is trapped at the grit chamber just before the pond entrance and is physically removed on a regular basis. There is a high concentration of suspended solids that have settled into the pond as bottom sludge.

The pond has accumulated a bottom sludge layer exceeding a half-meter in only a year of operation. If left untreated, the pond would be fully filled with bottom sludge within a few years and would be incapable of fulfilling its intended purpose as a flood mitigation pond. In addition to the sludge problem, extreme malodor emanating from the pond has affected nearby residences and has become a significant problem for the Jabatan Pengairan Dan Aliran Negeri (JPS). JPS has also expressed interest in reducing pollution to below Standard B before discharging into the sea to prevent harm to marine life. Standard B specifies BOD <50 mg/l and COD <100 mg/l.

The pond has an estimated volume of 25,000 m^3. On dry days, the grey water from Georgetown forms the bulk of the influent water. The estimated flow rate is 5,000 m^3 per day. This gives an average of five days retention time, which is ideal for biological treatment. The flow rate during heavy rain is not known; it is estimated at several times that of the normal dry day flow rate. The water in the pond can be completely replaced after a few days of heavy rain.

Bioaugmentation with MICROBE-LIFT® Technology Remediates Polluted Drainage Retention Pond in Penang, Malaysia

Objective

A bioaugmentation treatment program was developed to remove bottom solids and improve degradation of the waste organics. MICROBE-LIFT® technology, was recommended. MICROBE-LIFT® is a highly active liquid bioculture developed and manufactured by Ecological Laboratories Inc, USA. MICROBE-LIFT® contains a wide range of microorganisms elected for proven degradation capabilities targeting difficult to degrade organic waste components.

According to plan, treatment was conducted from the 29th of August 2005 to the 5th of March in 2006. A 10 ppm inoculation was performed on day one, a day affected by heavy rain immediately after inoculation. This was followed by an 8 ppm dose three days later followed by five additional doses of 4.5 ppm in the first month. Maintenance doses of less than 2 ppm, 12 gallons per week, were applied for the remaining period of treatment. Since retention time is limited due to increased rainfall and biodegradation can be enhanced by aeration, BioAktiv, an all natural mineral compound for oxygenation was added weekly to support MICROBE-LIFT® technology's stimulating enhanced degradation rates.

Results Achieved:

The first result noted within the initial month of treatment was the significant reduction in malodors experienced by workers and nearby residences. The bad odor was essentially eliminated throughout the treatment period in the pond area, with the exception of malodors near the influent to the pond on water that had not yet been treated. The S-10 MICROBE-LIFT® Bioremediation Project was showcased at the National Environment Seminar on 14-16 Dec. 2005, as organized by the JPS in Penang. Delegates invited to the site on 15 Dec 2005 confirmed that odor was no longer noticeable around the pond. Only from the incoming, untreated water were malodors noted.

As another indication of improved treatment, water samples of the pond also showed higher transparency (less turbidity) than in the past.

Water samples at the influent point of the pond and the effluent point near the discharge tidal gate were taken twice a month to monitor water parameters. BOD, COD, TSS, and total NH_4 were measured. The sludge thickness was also measured on the day of inoculation followed by three more measurements during the treatment period. Sludge thickness was measured by means of a sludge judge, a transparent glass tube inserted into the pond until it contacted the hard bottom.

The tube is then closed and brought to the surface where the captured column of sludge can be measured. An independent lab conducted the water sampling and analysis. The six-month treatment results are tabulated on the next page:

Bioaugmentation with MICROBE-LIFT® Technology Remediates Polluted Drainage Retention Pond in Penang, Malaysia

JPS Penang Retention Pond Project

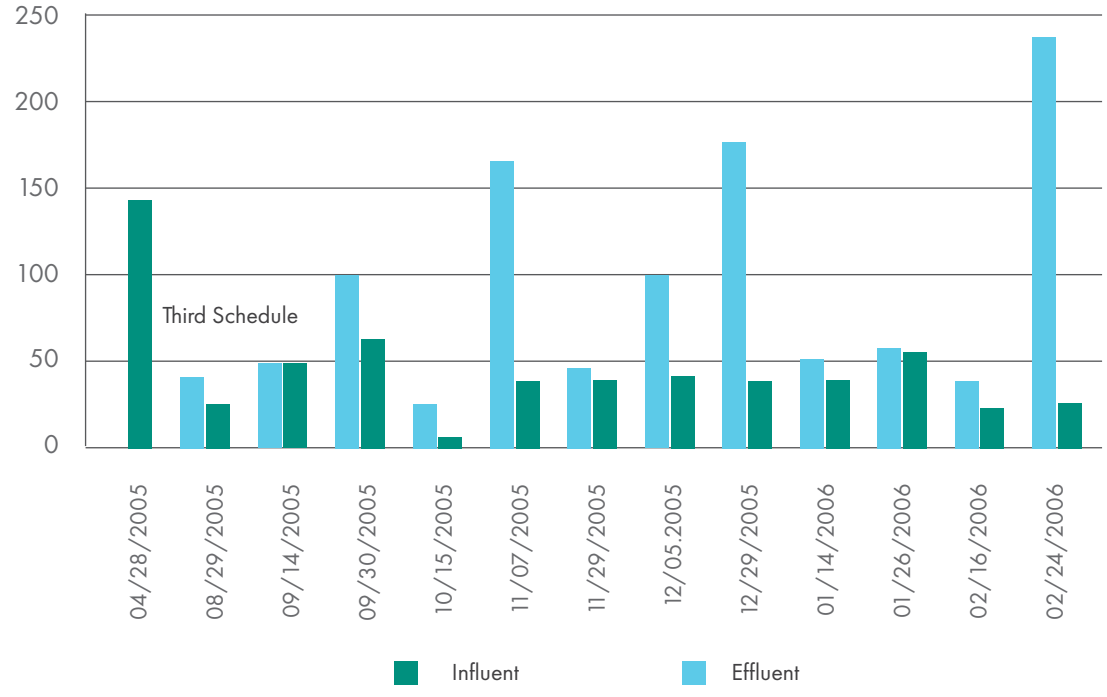
Water Parameter Measurements

Day	Date	Influent (at pump hose outlet)				Effluent (at discharge outlet)			
		BOD mg/l	COD mg/l	TSS mg/l	NH_2 mg/l	BOD mg/l	COD mg/l	TSS mg/l	NH_2 mg/l
	04/28					142	522	196	11.4
1	08/29	42	162	34	11.4	23	98	26	12.2
16	09/14	49	189	45	12.2	48	185	45	20.2
32	09/30	98	383	180	1.9	63	431	52	11.2
47	10/15	28	113	59	11.7	7	42	44	12.2
70	11/07	167	571	113	18.6	39	256	125	13
92	11/29	45	178	34	2.1	39	196	42	11.6
98	12/05	100	408	77	11.4	43	187	18	11.7
122	12/29	178	695	20927	20.4	40	167	51	9
138	01/14	52	197	71	15.4	39	161	56	14.4
150	01/26	59	279	70	15.6	56	223	41	15.6
171	02/16	39	158	50	20.6	22	86	41	13.6
179	02/24	235	975	598	17.4	24	95	37	8.6

Fig. 1: *This table shows actual data from the test period April 2005 through February 2006. Note the high effluent levels of BOD, COD, and TSS prior to treatment that were never reached again during treatment.*

Fig. 2: *The dramatic differences between influent BOD and the effluent levels show the treatment achieved through bioaugmentation. Note that treatment substantially improves after the first two months after the microbes have had a chance to establish themselves.*

Influent versus Effluent BOD



Influent versus Effluent COD

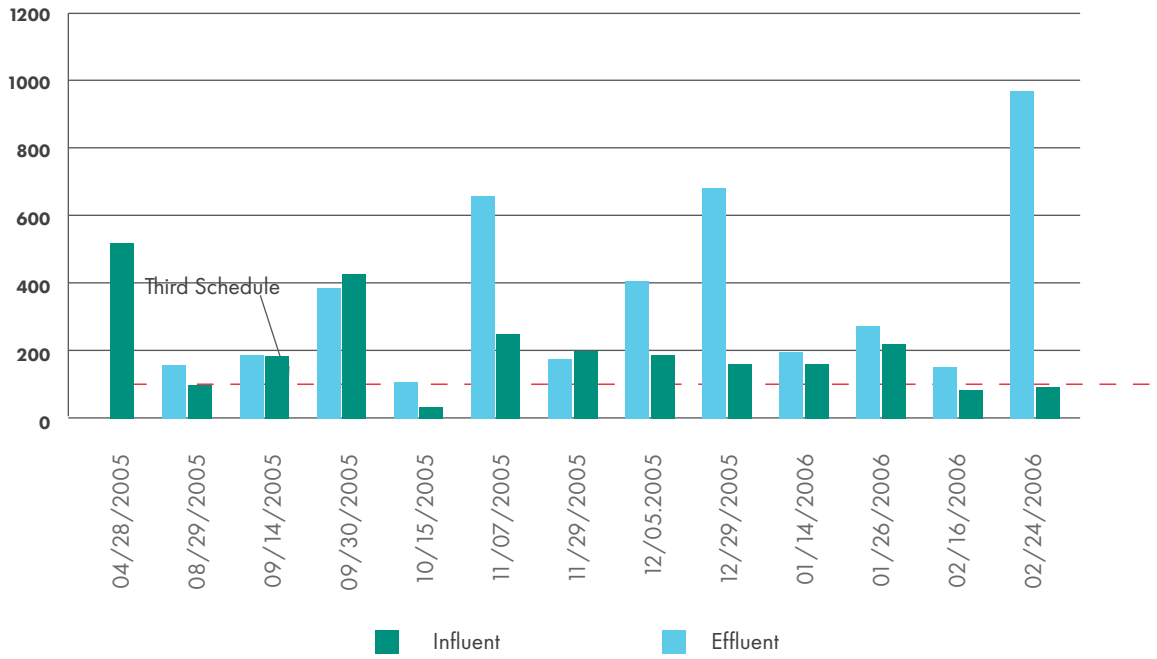


Fig. 3: *Consistent with the BOD data, COD results validate improvement in treatment. Data from the first two months represents a baseline prior to treatment, while the data thereafter shows substantially increased treatment based on greater differences between influent and effluent levels.*

The most significant change between influent and effluent water parameters occur after the first two months of treatment. This effect is typically seen in bioaugmentation applications, as the microbes inoculated require time to grow and establish themselves within the ecosystem. Significant water parameter improvement is observed starting in mid-October 2005. The data would not show much improvement during periods of heavy rainfall when influent water pollution levels are low. It was also noted that the water in the pond forms a circular motion when large volumes of water were discharged through the tidal gate or was being pumped out. The influent and effluent water was well mixed by this circular motion. As such, the water in the pond became more homogeneous and shows less difference between influent and effluent water samples. This factor explains the apparent non-performance of water parameters on 29 Nov 2005 and January 2006.

The bottom sludge continued to be reduced throughout the treatment period, and was practically eliminated by Feb 2006.

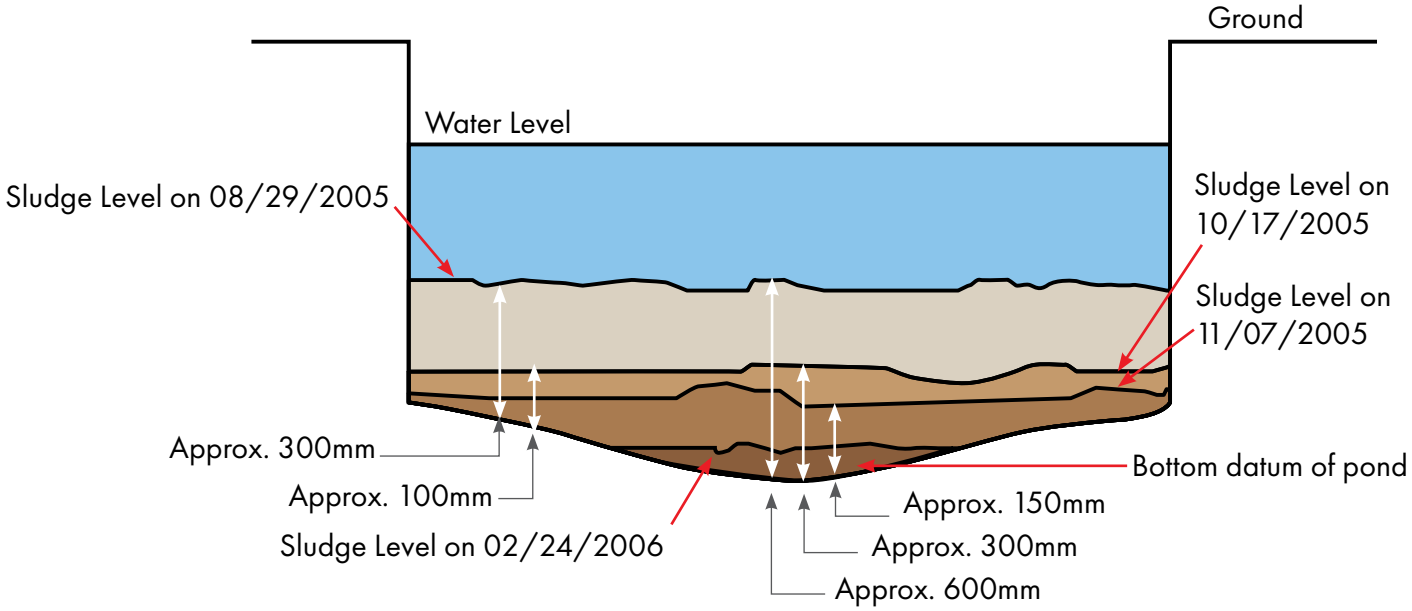
Average Sludge Level

Date	Side of Pond (mm)	Center of Pond (mm)
08/29/2005	300	600
10/17/2005	100	300
11/07/2005	80	150
02/24/2006	0	45

Fig.4: *This chart shows removal of accumulated sludge deposits ranging from a remarkable 93% to 100%*

Schematic Presentation of Sludge Thickness During the Treatment Period

Fig. 5: *This is a visual schematic of the reduction of bottom solids by the bioaugmentation program. A tremendous volume of sludge was virtually eliminated by biological degradation.*



The breaking up of bottom organic sludge often contributes to increasing amount of pollutants in the water as seen in the water parameters during the first two months of treatment.

It is important to note that as these bottom solids are degraded they are first broken down into smaller, soluble components that add to the water parameters of BOD, COD, and TSS until they too are degraded. This is another factor seen in the water parameters during the first two months. As the bottom sludge is reduced we expect to see faster improvement in the influent vs. effluent water parameters. This is clearly reflected in the effluent water parameters taken on 24 Feb. 2006 where the discharge of BOD, COD, and TSS now meet the Standard B regulatory requirement despite the pond experiencing the
highest pollutant input load during the entire treatment period.

Based on comparing the initial benchmark sludge measurement with the most recent measurement made on 24 Feb 2006, an estimated 6,000 m^3 of sludge has been degraded by MICROBE-LIFT® technology's environmentally friendly bioremediation process. Based on RM 80 per m^3 of dredging and dumping cost, the biological sludge removal saved the Board over half a million ringgitt, making it a very cost effective solution. And in addition, MICROBE-LIFT® technology eliminated the bad odor in the surrounding area of the pond and improved the quality of the water before discharge to the sea.

In this trial, led by Goh Kwang Beng of MICROBE-LIFT® ASIA and Oakwell Engineering Ltd of Singapore, MICROBE-LIFT® achieved results well beyond JPS's initial targets of odor control and water quality improvement. MICROBE-LIFT® technology improved the water quality to obtain parameters better than the required Standard B, effectively eliminated the odor problem, and achieved sludge reduction far exceeding expectations. This sludge reduction has restored the pond to its intended function.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS13103

Bioaugmentation with MICROBE-LIFT® Technology Reduces Sludge Production by over 25%

Location: **Bath Regional Wastewater Treatment Plant, Zeeland, Holland**

Background: The Bath WWS is a regional facility that covers many small communities over a large area serviced by a network of domestic sewage collection conduits. Total Population Equivalent (PE) of 537.000 is pumped to this central facility on the coast of Southern Zeeland. The facility is a well designed and operated wastewater treatment plant. The basic design brings the domestic sewage to a gross filter and then into a collection diverter that separates the flow into 4 trains. In each of the trains, the first tank is a covered primary (facultative) receiver, covered with thick floating Styrofoam sheets to lower odor emissions. From here it flows into an aeration tank system, and then onto large settling clarifier. After this point, the flow is dewatered and the pressed cake is further processed in anaerobic chambers.

Objective: The system was operating well, but the plant had periodic odor issues and they wanted to lower sludge handling costs. MICROBE-LIFT® Technology Products were recommended for a 12-week trial period and a monitoring schedule was recommended that would determine the effect of treatment.

Results Achieved

As the tracking data shows on the next page, bio-augmentation with MICROBE-LIFT® was able to improve the general performance of the facility as well as to significantly reduce sludge generation and the associated handling costs.

The trial collected data for six weeks prior to treatment and compared this to twelve weeks when MICROBE-LIFT® formulations were applied. MICROBE-LIFT® bio-augmentation products were able to improve the general performance of the facility and, over time, this treatment will certainly improve upon plant performance even further without any danger of disruption. Qualitatively, the issue of odor was resolved. The most important benefit was the reduction of sludge handling costs by 27.8% percent.

The actual treatment data follows:

MICROBE-LIFT®/ Treatment - Tracking Data

Removal Percentage Rate

WEEK	CZV COD	BZV BOD	NKi-N Nitrogen	NH4-N Ammonia	Ntot-N Total N	TZV D.O.	Ptot-P Total P	O.B.	Sludge Percentages	
Pre-treatment									Indamprest	Removal
16	87.3	95.3	96.8	98.7	83.7	90.9	63.8	91.2	0.7	52.8
17	85.4	96.1	96.5	99.0	80.7	90.5	63.0	90.9	1.1	53.3
18	68.4	96.0	91.5	96.7	67.5	82.7	30.9	92.7	0.9	54.1
19	76.9	95.8	95.3	98.3	83.4	86.9	72.0	92.3	1.0	53.3
20	82.8	95.7	96.0	98.9	82.1	88.6	70.5	91.8	0.8	50.4
21	88.1	96.1	96.7	99.1	85.1	90.2	53.0	92.1	1.1	53.7
Average	**81.3**	**95.9**	**95.5**	**98.5**	**80.4**	**88.3**	**58.9**	**91.8**	**0.9**	**52.9**

MICROBE-LIFT®/ Treatment - 6 Weeks

22	91.3	97.2	96.0	99.8	88.6	93.3	60.8	94.5	0.9	54.8
23	94.5	98.0	97.1	99.7	89.3	95.7	67.8	97.6	0.7	56.4
24	93.3	97.7	98.3	99.7	90.1	95.4	70.9	95.9	0.8	57.3
25	91.8	98.3	98.3	99.9	90.3	95.8	72.3	94.8	0.7	57.9
26	94.3	99.1	98.0	99.8	89.8	96.8	73.9	95.7	0.6	60.1
27	95.1	98.2	98.8	99.7	90.2	97.1	74.4	98.1	0.6	61.3
Average	**93.4**	**98.1**	**97.7**	**99.8**	**89.7**	**95.7**	**70.0**	**96.1**	**0.7**	**57.9**

MICROBE-LIFT®/ Treatment - (6 through 12 Weeks)

28	94.6	98.3	99.8	99.9	90.2	95.5	73.2	96.2	0.6	61.3
29	95.2	98.6	98.9	99.7	89.8	96.9	74.0	97.8	0.6	61.9
30	95.5	98.8	98.3	99.6	91.4	97.3	75.1	96.9	0.6	61.8
31	94.7	98.0	98.5	99.8	92.3	97.4	75.3	97.9	0.6	63.2
32	95.1	98.3	99.1	99.9	90.7	96.0	73.8	96.7	0.5	64.1
33	94.9	99.1	99.3	99.6	91.9	97.3	74.2	98.2	0.7	64.4
Average	**95.0**	**98.5**	**99.0**	**99.8**	**91.1**	**96.7**	**74.3**	**97.3**	**0.7**	**62.8**
Percent Improvement	16.9	2.7	3.7	1.1	13.3	9.5	26.1	6.0	33.3	21.0

Since most activated sludge plants spend approximately half of their operating costs on sludge handling and disposal, a 28% reduction in these costs is a major benefit to the bottom line.

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CS13105

Well-Operated Municipal Plant Achieves $130,000 Cost Savings from Microbe-Lift® Technology in Deutsch-Wagram, Austria

Location: **Deutsch-Wagram Municipal Treatment Plant, Austria**

Background: The sewage treatment plant of the borough Deutsch-Wagram is situated in the south west of the settlement on the left shore of the Rußbach and has been in operation since 1969. The drainage area is 350 hectares and the degradation performance is more than 90% based on mechanical, chemical and biological treatment. The waste water entering the sewage work at the supply tank is lifted up with screw pumps to the level of the sewage work and passes through a bar screen. A mechanical scraper removes coarse matter from the waste water. Then, the wastewater flows through the circular degritter where granular components are separated. Through a distributor structure the mechanical pre-cleaned wastewater enters the activated sludge tank with a capacity of 1440 m^3. The biological treatment is carried out by the activated sludge process. To cover the oxygen demand, air is supplied with cage rotor aerators into the wastewater. In the secondary settling tank, with a capacity of 2.300 m^3, the sludge settles down and is separated from the wastewater, treated biologically, then discharged to the receiving water (Rußbach). Through a siphon pipe the settled sludge enters the sludge recycling pump station. With screw pumps the sludge is pumped back into the activated sludge tank.

The quantity of water for a population equivalent of 8.200 is treated in the activated sludge tank, designed for a population equivalent of 6.000. The chemical cleaning is carried out with the addition of iron salts to precipitate phosphorous from the wastewater and is removed with the excess sludge from the process. Nitrates can be removed (denitrification) with high efficiency from the wastewater when operated with that objective. The sludge is thickened in the sludge storage tank and the sludge liquor pumped back into the supply tank. The thickened sludge either can be directly used in agriculture or the produced sludge granulate is scattered on the fields after de-watering with a sludge press.

Objective: The plant is operated by an O&M firm from the Netherlands. Located close to a residential area, the plant had regular problems with odors and oil & grease buildup in the head-works and aeration basins despite achieving better than 95% reduction for BOD and TSS. In addition, the plant was expending a significant portion of its operating budget for sludge handling and disposal.

A bioaugmentation program was implemented in 1998 for a period of one year to determine if the bioaugmentation program could consistently reduce the amount of sludge generated in the plant. Improving odors and oil and grease breakdown were secondary objectives but were not considered to be enough on their own to justify the cost of product treatment, approximately US $30,000/ year.

Fig.1: *Wastewater Plant at Deutsch-Wagram*

Deutsch Wagram

Dosages:

Table 1. Average of some main parameters from the annual report of 1997

parameter	average / year	unit	degradation eff.
Waste water / d	1320	m^3/Tag	-
Sludge volume	810,2	ml/l	-
$BSB_{5:}$ supply	286,3	mg/l	-
BSB_5: discharge	5,4	mg/l	98,0 %
CSB: supply	574,5	mg/l	-
CSB: discharge	39,1	mg/l	92,5 %
NH_4-N: supply	47,5	mg/l	-
NH_4-N: discharge	1,4	mg/l	97,0 %
NO_3-N: supply	33,2	mg/l	-
NO_3-N: discharge	4,8	mg/l	85,5 %
PO_4-P: supply	5,6	mg/l	-
PO_4-P : discharge	0,5	mg/l	91,4 %

Fig. 2: Average values of some main effluent parameters from the annual report of 1997.

Dosage Schedule for MICROBE-LIFT® Technology in the Sewage Work of Deutsch-Wagram:

Dosages were recommended based on loading (COD; BOD5, resp. hydraulic loading) degradation efficiency, problem zones and working capacity.

Before initial inoculation, 2 gallons of MICROBE-LIFT® formulation were applied in the pump station, supply tank, and secondary settling tank. The addition was carried out either by direct applying or spraying in a dilution of 1:10 to 1:50 with water in a water can.

Initial treatment, start on 1st April

April 1998, ¼ gallon was applied on the floating layer and the sidewalls of the supply tank near the pump screw in a dilution of 1:10 with water. 4 gallons were applied into the activated sludge tank. On the floating layer of the secondary settling tank ¾ of a gallon was sprayed in a dilution of 1:10.

On April 2.1998, at 3 a.m. 1 gallon was added at the pump station.

Dosage schedule:

1 US gallon = 1 bottle = 3,7853 liter		gallons per month
Initial:	6 gallons	
Next four weeks (once per week):	1,5 gallon	6
Maintenance (once per week):	1 gallon	2

Deutsch Wagram

Dosages

Next four weeks once per week:

9.4.1998	1 gallon was added into the activated sludge tank
17.4.1998	1 gallon was added into the activated sludge tank
23.4.1998	1 gallon was added into the activated sludge tank
30.4.1998	1 gallon was added into the activated sludge tank

Maintenance once per week:

8.5.1998	½ gallon was added into the activated sludge tank
13.5.1998	½ gallon was added into the activated sludge tank
20.5.1998	½ gallon was added into the activated sludge tank
28.5.1998	½ gallon was added into the activated sludge tank
6.8.1998	½ gallon

If required (based on seasonally high flow rates) at the pump station, into the supply tank and into the secondary settling tank MICROBE-LIFT®/IND is applied additionally.

Results Achieved

After collecting one full year's worth of data, it was determined that for the year, under slightly higher flow and organic loading, that the plant had generated 34% less sludge for handling and disposal, reducing the cost for chemical treatment as well as for transportation and disposal.

Additional benefits included improved solids settling characteristics as reflected by the SVI, reduction of the odors from the plant and a significant reduction in the oil & grease buildup.

Table 2. Sludge pressing results:

	without	with MICROBE-LIFT®/IND
Duration of pressing	24.7.98-1.8.98;	9.12.-17.12.98
volume of raw sludge	2083 m3	1330 m3
TS - of press-cake %	26	31
press-cake t	270,18	178,12
	- 2 day -	753 m3
		+ 19 absolute
		- 92,06
1.12.-10.12.97	2065 m3	25	208,41
9.12.-17.12.98	1529 m3	27	194,46
- 1 day	-536 m3	+ 8 absolute	-13,95

Fig. 3: *This chart shows a comparison of the duration of pressing and the volume of sludge when treated with AquaClean vs. without treatment.*

Deutsch Wagram

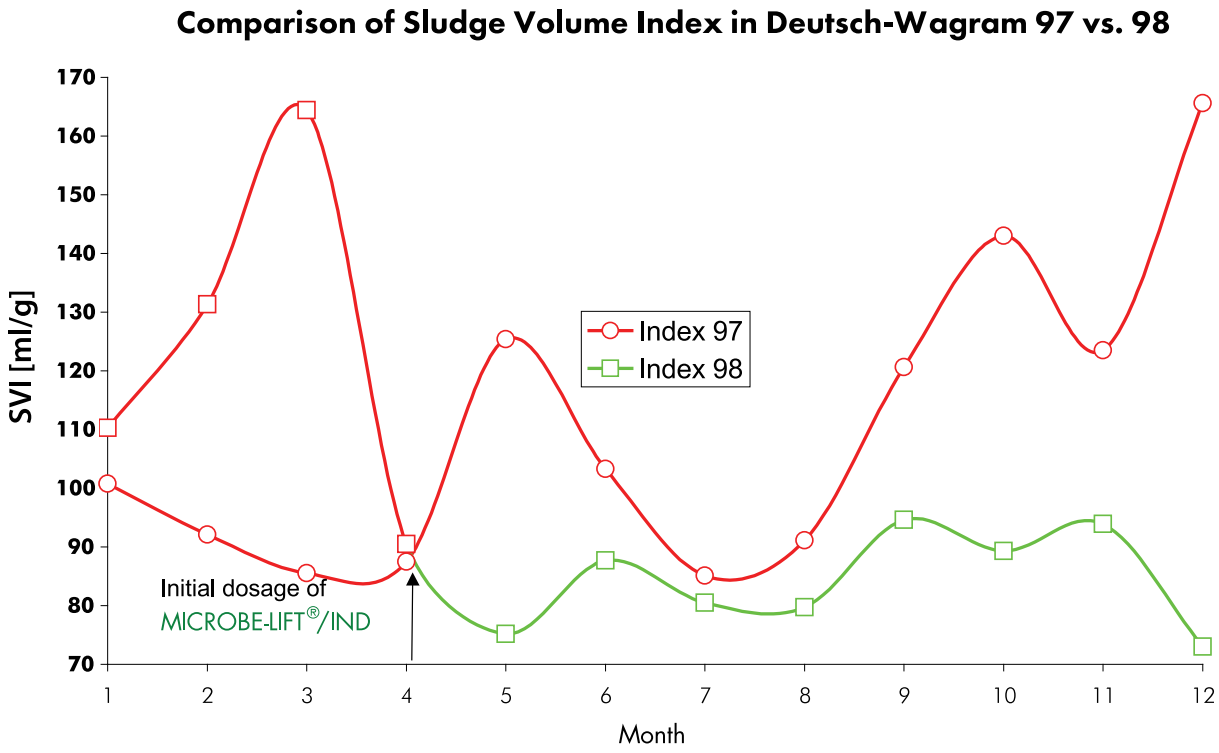


Fig 4: *SVI Data from Deutsch-Wagram*

Sludge handling and disposal costs were reduced by US $160,000 resulting in a net operating cost savings of US $130,000.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS13107

Municipal Lagoon Treatment Efficacy Was Restored in LaCosta, Uruguay

with MICROBE-LIFT® Technology

Location: **La Costa, Uruguay**

Background: This municipal lagoon receives 240,000 litres of domestic sewage per day. Treatment efficacy had been reduced to the point that the town was having difficulty meeting discharge parameters and malodors and the presence of insects such as flies and mosquitoes were causing complaints from the local community.

Objective: Ecological Labs developed a treatment program using of MICROBE-LIFT®/IND. A total dosage rate of 322 litres was applied over a period of six weeks.

Results achieved: Dramatic results in surface scum were seen by the third week as all waste parameters started to improve. At the end of the six-week treatment the water had been purified 85% and was certified for use in farm irrigation. The pH had been raised to 7.2 and the Biochemical Oxygen Demand (BOD) was reduced from 480-ppm initial concentration to 130 ppm after treatment, a reduction of 73%. All noxious odors were eliminated, as was the presence of insects.

Week 1

Week 2

Fig. 1: *The pond has a layer of scum that is starting to break-up. Clear patches are evident after two weeks of treatment using MICROBE-LIFT® technology*

Week 3

Week 4

Week 5

Week 6

Fig. 2: *The above pictures show the progression of improvement and the efficacy of treatment with* MICROBE-LIFT® technology. *Surface scum was eliminated and effluent quality improved sufficiently to be used for farm irrigation.*

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS13108

An Average Reduction In Sludge of Approximately 20% Was Observed at Zutphen Plant in the Netherlands

Location: **Zutphen Municipality Netherlands**

Background: Zutphen is a medium sized activated sludge system treating an average of 6,600 M^3 of wastewater per day. The plant comprises two parallel trains with segregated recycle lines so that a side-by-side comparison could be conducted.

Fig. 1: *This picture shows the parallel aerated basins side by side. Since these trains have segregated recycle lines they can be treated separately and the sludge from each train can be evaluated and compared.*

MICROBE-LIFT® is **Ecological Laboratories'** core wastewater technology.

Based on the successful sludge reduction experience in municipal wastewater treatment plants, Zutphen worked with **Ecological Laboratories** to plan a trial in their plant.

Objective: In March 2006 the City of Zutphen initiated a 120-day trial augmentation program. Their goal was to increase biological treatment reducing the yield of sludge. Two products were applied to Train AT2, MICROBE-LIFT® technology and a natural organic compound known to potentiate the sludge reduction capabilities of MICROBE-LIFT® technology in past applications. Train AT1 was left unseeded as a control. The design of the plant was ideal for testing since each train handled their sludge independent of the others.

Results Achieved: Within 60 days, an average reduction in sludge of approximately 20% was observed from the treated train with a maximum reduction of 26% observed late in the latter part of the 60-day period. Between the 60th and 90th day of the trial some settling instability was observed as was typically observed in the transition from cold weather to warm weather operation. Once through the transition the plant quickly stabilized and again a sludge reduction was observed in the treated train, but for this time period was in the 12% to 16 % range. Upon further evaluation of the data and process, it was determined that there was some comingling of the supernatant from the digestors, leading to an inadvertent low-level seeding of the control train. While the differential between the seeded and "control" trains had been reduced, a comparison to historical sludge production numbers indicated that both trains were generating on the order of 20% reduction, despite higher hydraulic and organic loadings in 2006.

Zutphen Sludge Reduction Trial

Sludge Wasted (Kg)

	AT1	AT2	Average	Average/Day
Q1: 1 Jan to 13 March	250,597	252,883	251,740	3496
Q2: 14 March to16 July	319.136	319,136	319,136	2574
			% Reduction	**26.4%**

Fig. 2: Sludge reduction efficiency improvement during trial exceeds 26%. This was achieved in spite of dramatically increased BOD & TSS loading.

Another typical measure of sludge production is the yield coefficient, which is measured by the equation:

$$\frac{\text{Solids Processed} - \text{Cum Solids inf (kg)}}{\text{Cum BOD inf} - \text{Cum BOD eff}}$$

The calculated yield coefficient for the trial period is 22.4% lower than for the period immediately before the trial in 2006 and 36.1% lower than the yield coefficient for the same period in 2005. (Actual data available)

These impressive results validate the potential sludge reduction benefit of bioaugmentation even when applied to a very well operated system. Since sludge treatment and handling accounts for approximately 50% of the overall cost of wastewater treatment, reduction in sludge volume is a very cost effective benefit.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS13109

MICROBE-LIFT® Technology Improves Efficiency of Anaerobic Digesters in Columbia - Preventing Costly Expansion

Location: **Empresas Publicas, Columbia**

Background: **Ecological Laboratories Inc.** was contacted by Empresas Publicas to determine if bioaugmentation with MICROBE-LIFT® technology could assist in the operation of their anaerobic digesters.

The facility consisted of two anaerobic digesters of 7,900 M^3 each. The average flow rate was 1.8 M^3 per second giving an average hydraulic retention time (HRT) of 21 days. The VSS reduction being achieved prior to the bioaugmentation program was approximately 30% for both reactors.

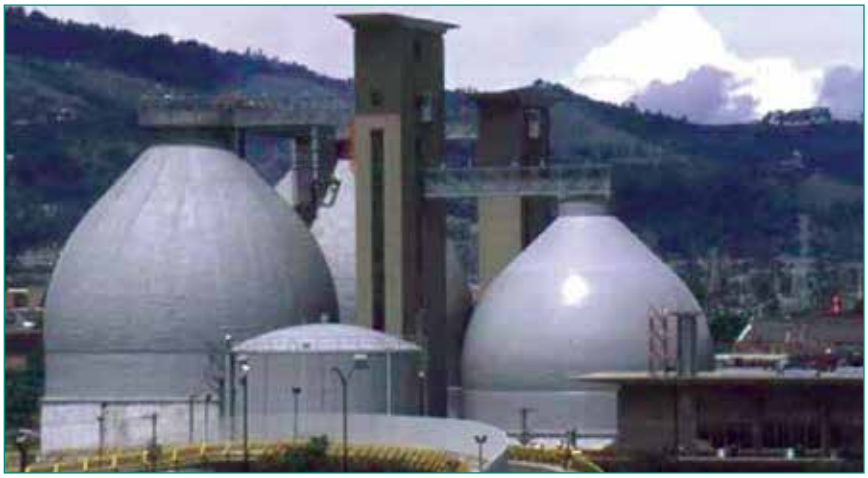


Fig.1: *Anaerobic digesters at Empresas Publicas*

Objective: The objective of the program was to reduce odors associated with the operation of their anaerobic digesters and improve VSS reduction.

After thorough evaluation of their system, a plan was developed using MICROBE-LIFT® technology. On the first day, the reactors were dosed at a rate of 12 mg/l based on the volume of the reactors. Thereafter, a weekly dose of 4 mg/l was applied for the next four weeks, followed by a 1.5 mg/l weekly maintenance dose.

Results Achieved: Six weeks after the initial dosage, VSS reduction had been increased to 37% versus a target of 50%. This improvement allowed the plant to handle the existing load without the immediate addition of a third reactor.

The plant also achieved significant reduction in odors in and around the plant.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS13110

Made in the USA

Bioaugmentation Reduces Sludge Production 20% Allowing Digester to Handle Increased Load in Hod Hasharon, Israel

Location: **City of Hod Hasharon, Israel**

Background: Hod Hasheron's municipal waste treatment system includes anaerobic digesters utilized to reduce sludge volume before disposal. Average daily flow into the plant is approximately 25,000 M^3/day. The overall performance efficiency of the plant is excellent.

Objective: Based on results achieved in the anaerobic digestors at Pusan and Empresas Publicas, the Operations Staff at Hod Hasharon made a decision to determine if similar results could be achieved in their plant. Unlike the other plants, Hod Hasharon was also interested in whether or not an increase in biogas production could be realized since they recovered the gas for use as a fuel source.

Results Achieved: After the first three months of treatment with MICROBE-LIFT® technology, results were compared to historical values from the previous 15 month operating period. In spite of a 1.8% increase in loading to the plant based on a hydraulic and organic basis, the amount of sludge that was removed from the plant was reduced by 18% with a concurrent increase in biogas of 11.3%.

The following chart shows the actual data developed by the city.

Table 4: Operating Data from Hod Hasharon

BIO-GAS	Solids Vs WAS	SOLIDS Tons	% SOLIDS	Dry Sludge	Sewage in m3	RAS m3	WAS m3	
126635	0.42%	139	16.20%	858	796800	255870	32745	1/28/2004
106633	0.45%	129	16.60%	775.5	738833	243050	28593	2/28/2004
115413	0.44%	141	16.10%	874.5	774194	212910	32289	3/28/2004
112470	0.32%	118	15.60%	759	746850	238970	37522	4/28/2004
111817	0.42%	156	14.80%	1056	756214	230610	36870	5/28/2004
119430	0.34%	125	13.50%	924	730080	218740	36847	6/28/2004
159154	0.37%	122	14.20%	858	644940	193520	32969	7/28/2004
131719	0.46%	164	15.50%	1056	695370	212240	35870	8/28/2004
150030	0.38%	136	14.70%	924	677590	213870	35351	9/28/2004
147219	0.41%	153	15.00%	1023	730670	231090	37845	10/28/2004
138930	0.51%	151	15.80%	957	602680	182340	29630	11/28/2004
140585	0.45%	154	16.10%	957	742290	265340	34018	12/28/2004
140864	0.46%	144	15.60%	924	715640	332910	31392	1/28/2005
131488	0.39%	132	16.00%	825	755250	345860	33830	2/28/2005
142383	0.33%	141	15.30%	924	706748	365820	42207	3/28/2005
139350	0.29%	143	18.90%	759	763127	329610	49042	4/28/2005
151032	0.27%	146	19.20%	759	724080	324160	53732	5/28/2005
144330	0.31%	152	20.90%	726	715070	305420	48967	6/28/2005
								7/28/2005
								8/28/2005
								9/28/2005
								10/28/2005

Fig. 1: *Operating data from Hod Hasharon shows the drop in dry sludge and the increase in biogas.*

Made in the USA

This data represents good correlation between the reduction in VSS and the increase in biogas production, making it reasonable to assume that the increase in biogas production is a result of the improved VSS reduction efficiency.

Typically with effective bioaugmentation programs, results may continue to improve as the microorganisms become better established in the population. Current treatment, during the summer of 2006, has obtained even better results in the effluent properties of TSS and BOD with sludge reduction over 20%. The plant has also experienced a significant reduction in odor.

MICROBE-LIFT® technology has consistently shown benefit in anaerobic sludge reactors for sludge reduction and odor control

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS13111

Bioaugmentation Remediates Heavy Organic Loading in Municipal Oxidation Pond in Drakenstein, South Africa

Location: **Drakenstein Municipality, Western Cape Province, South Africa**

Background:

The primary influent pond is in a series of seven oxidation and maturation ponds serving the municipality of Drakenstein, S. Africa. This system was designed to allow the final maturation pond to be a polishing pond for nitrification to allow effluent of suitable quality to be discharged to the river. However, due to the high level of incoming organics the initial ponds are not effective enough to allow the system to work as designed. The key to this system is to improve treatment in the initial influent pond to a level that allows efficacy in the remaining system.

Drakenstein Municipality was approached in mid-October 2009, with a request to participate in a field trial for the bioremediation of wastewater/sewerage effluent. The municipality offered Pond #1 at the Gouda sewerage oxidation and maturation pond site. This site was deemed ideal for the trial, as the two influent ponds (Pond #1 and Pond #2), are practically the same in size and conditions. Pond #1, being the primary influent pond, had higher average values for Chemical Oxygen Demand (COD) and Suspended Solids (SS).

Objective:

The water conditions in Pond #1 were found to be above the Department of Water Affairs (DWAF) limits on both the COD and SS for the "discharge of wastewater into a water resource (1999)". The 7-year average and August 2009 water parameters, taken from the municipal laboratory results are given in the table below. These parameters give the starting point for the remediation.

PARAMETER	7 YEAR AVERAGE	AUGUST 2009	DWAF LIMIT
COD	410	388	75
SS	78	177	25
pH	8.6	7.8	5.5 - 9.5

Fig. 1: *Data on organic loading in pond #1 prior to treatment.*

The goal of a successful field trial is to reduce the pH, COD and SS values being equal to or lower than the DWAF limits and/or remediation of the water to the point where the water is able to support the natural aquatic flora and fauna associated with a settling dam.

In order to keep the field study true to conditions generally found in the Southern African arena, no special or proprietary equipment was used in the application of the bioremediation product. The product was poured by hand standing on the edge of the dam. As a boat was available for the initial inoculation, product was poured from the boat as it was tracked diagonally across the dam.

The dosing regime for the MICROBE-LIFT® products is shown in the table below. Dosage is shown in gallons. The MICROBE-LIFT® formulation was added at the calculated standard dosage for a volume of effluent equal to 2000 m^3

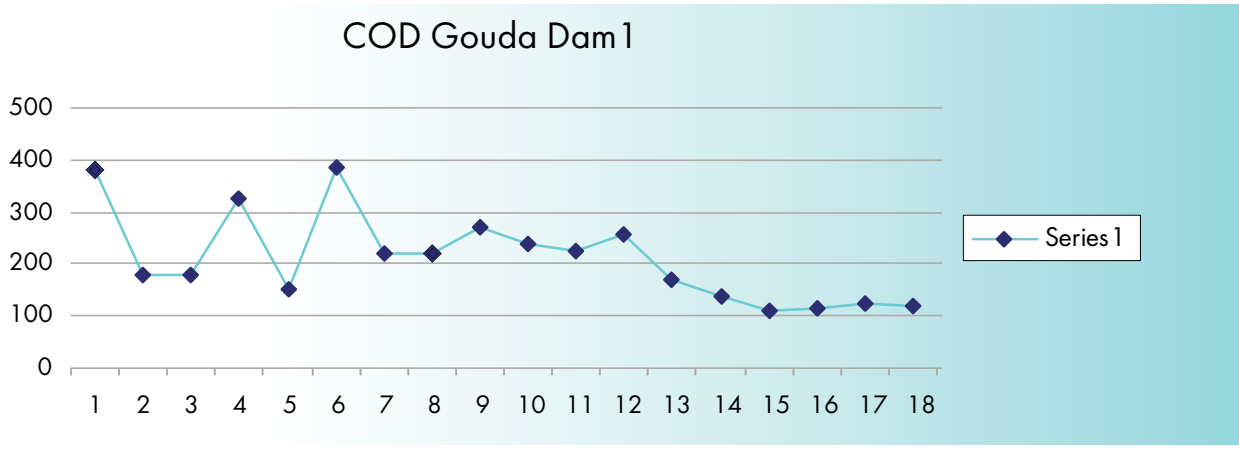
PRODUCT	WEEK 1	WEEKS 2 - 5	WEEKS 6 - 27	ADDITIONAL
	Inoculation 12/10/2009	per week	per week	For 2 weeks 05/02/2010
MICROBE-LIFT® #1	16	8	2	
MICROBE-LIFT® #2				3

Fig.2: *This chart represents the dosage schedule for the field trial. During the trial it was decided to add another MICROBE-LIFT® product, for two weeks to assist in degrading bottom solids.*

Samples were drawn from the same area as those drawn for the municipal samples. This sampling area on the southern side of the dam, 10m from the southeast corner, provides a small concrete platform where hand samples may be gathered. Duplicate samples were taken on a weekly basis, or more often if deemed necessary. The sample was collected in sterile 1-liter sample bottles with sealable lids. Once the sample was taken the lid was sealed and the sample packed into a polyurethane cooler to keep the sample temperature stable. Sealed samples were delivered to the laboratory for analysis.

Results Achieved:

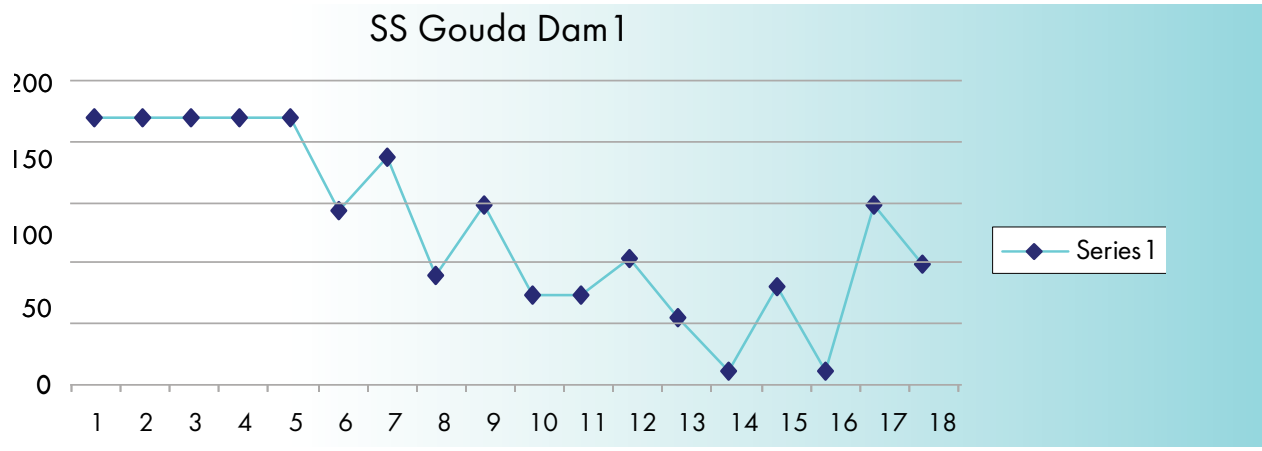
The following graph shows the COD (chemical oxygen demand) data in pond #1for the 18 weeks of the trial:



The results show the downward trend of the COD and SS values, these being the two main indicators of water quality. The pH value measured was well within limits at all times during the trial.

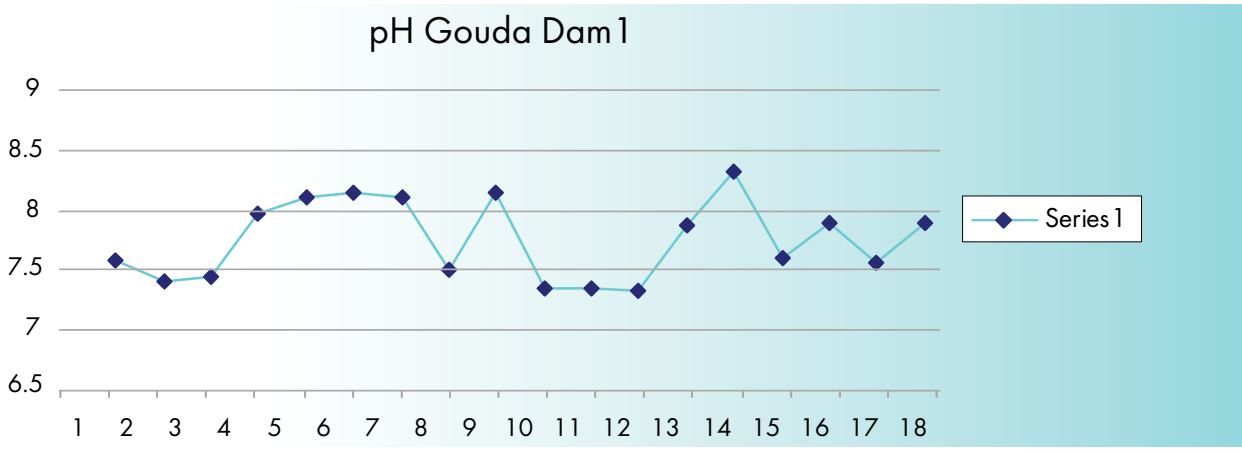
The overall downward trend of COD is due to the ongoing oxidation of organics and inorganics present in the water plus the corresponding suspended solids released to the water as the solids in the benthic sludge layer are solubilized. This trend will continue until the benthic sludge layer is removed and a steady state between influent and effluent from the pond is achieved. It is estimated that this value will reach DWAF limits by week 22 and can be accelerated with the application of a second MICROBE-LIFT product if required. The spikes seen at weeks 4 and 6 are due to the release of soluble organics from the benthic sludge layer, due to the population growth of the bacterial consortium.
The decline shown from week 12 to 18 is due to the addition of 6 gallons of MICROBE-LIFT SA over weeks 11, 13 and 16 to accelerate the solubilization of the sludge layer. Further application of the second product is required to reduce the COD value to below 75 mg/l.

Suspended solid (SS) data for the trial period are provided below:



The overall downward trend of the SS value is due to the ongoing solubilization of organics present in the benthic sludge layer and the corresponding release of soluble organics suspended in the water. The spikes seen at weeks 7, 9, 12, 15 and 17 are due to the release of soluble organics and inorganics from the benthic sludge layer, due to the addition of MICROBE-LIFT SA. This product is specifically formulated for the biological oxidation of slow-to-degrade organic solids. Once a steady state of oxidation is reached between influent and effluent this value will remain substantially below the DWAF limit of 25 mg/l.

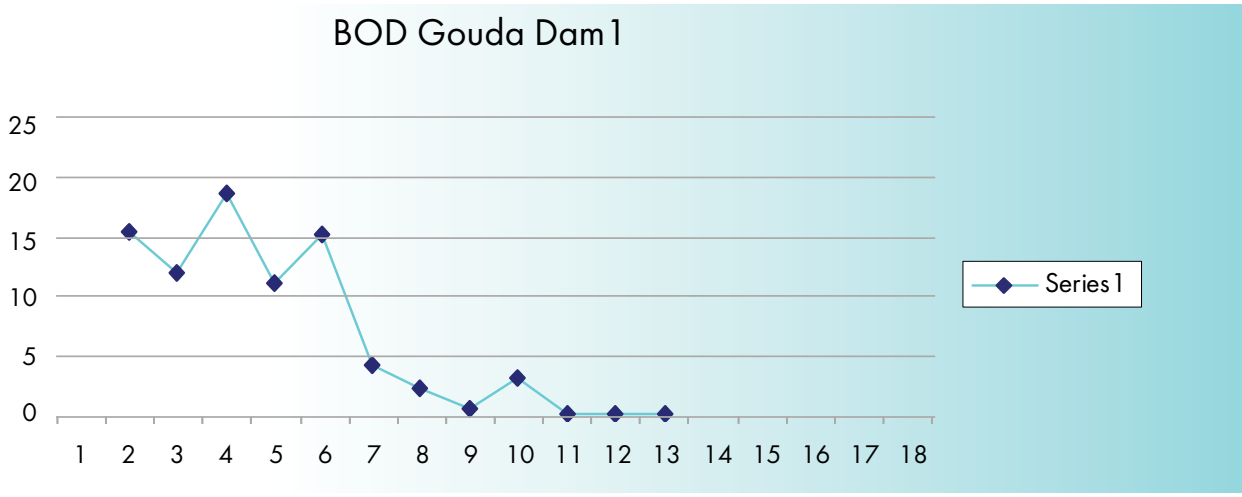
pH remained in the 7.5 to 8.5 range throughout the trial as shown in the graph that follows:



Throughout the trial, the pH varies from 7.5 to 8.5.

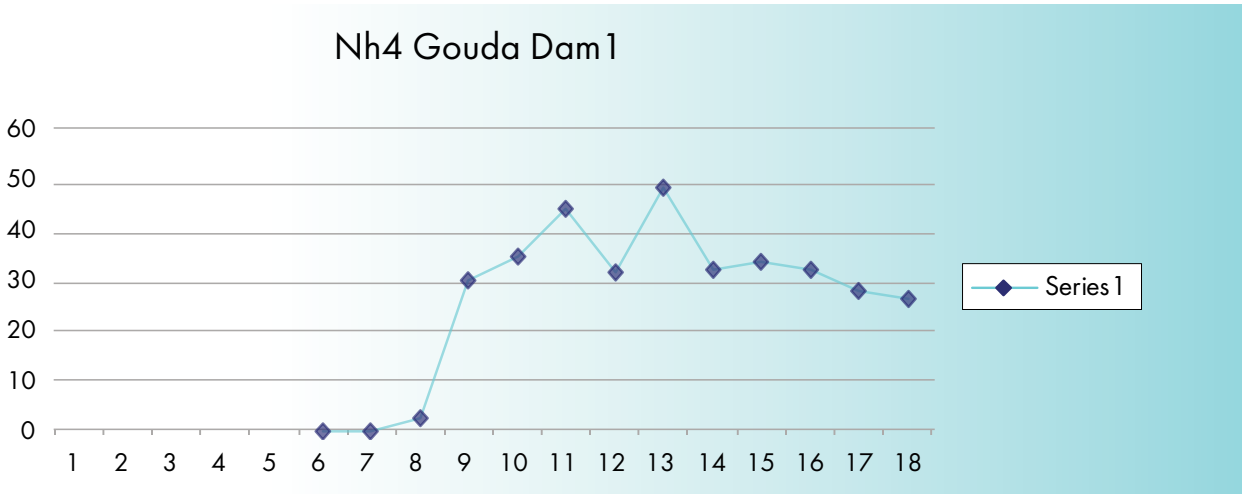
The pH has remained well within DWAF limits for the 18 weeks of this trial. This value is not expected to change by any great amount in future. The small variations seen are usually due to the breakdown of organic acids that lower the pH. In the anaerobic conditions in the benthic zone it is not uncommon for the formation of these organic acids by acetogens.

BOD (Biological oxygen demand) levels are indicative of the biodegradable portion of the waste. The excellent reduction of BOD shows the efficacy of the bioaugmentation program.



As can be seen from the graph, the majority of organics present in the pond were solubilized and oxidized between weeks 6 and 13. The sampling and analysis for BOD was discontinued after a 3-week steady state was incurred. The spikes seen at weeks 4, 6 and 10 are due to the population growth in the bacterial consortium after dosing. The COD and SS values tend to lag the BOD trend by approximately 2 weeks, this is due to the action of the bacterial consortium on the more easily oxidized organics as opposed to the more difficult to solubilize organic sludge.

Ammonia (NH4) elevates as sludge containing nitrogenous compounds is broken down.



As the breakdown of organic sludge solids in the benthic layer throws ammonia into the water phase, they will be removed over time by heterotrophic uptake or through natural nitrification and denitrification. During nitrification ammonia is converted to nitrate and then into nitrogen gas and released. The ammonia is expected to drop to the 0.1 to 0.2 ppm range as the COD value is dropped to below 75mg/l.

Significant events

As can be seen from the graphs, after the initial inoculation of the MICROBE-LIFT product in week 1, the bacterial consortium growth peaked in week 3. From this peak the organic/inorganic sludge layer in the benthic zone began to be solubilized. As dosage continued further peaks were experienced with each dosing until week 10, by which time the BOD had normalized. The COD, however, remained stubbornly in excess of 200 mg/l. In order to assist the reduction of the COD value, MICROBE-LIFT SA was added in weeks 11, 13 and 16. The addition of SA then provided the catalyst for COD reduction as the insoluble components of the benthic sludge layer were solubilized and freed for oxidation. Due to the large sludge component deposited over years, this value will reduce below the 100 mg/l as the final sludge layer is oxidized.

It is interesting to note that the natural aquatic fauna returned to the pond in week 13, where a population explosion of Daphnia, Platana and other aquatic life appeared. This aquatic life is still present in the pond and the possible introduction of fish is being investigated.

Conclusions:

Using the calculated dosage rates, bioremediation of the pond was achieved in 13 weeks. This was a week longer than the original estimation of 12 weeks. Bioremediation has dropped the BOD, SS and COD and led to the appearance of natural fauna in week 13. Interestingly the fauna appeared at the peak of the ammonium cycle, where it is shown that ammonium is not harmful to certain fauna at the pH levels experienced.

In March 2010, Gouda began a rehabilitation process for the ponds and piping, which resulted in the ponds being pumped to very low levels. The low levels exposed inaccessible areas of the ponds and have given new insight into the COD value seeming to stabilize at approximately 100 mg/l. Significant sludge deposits were exposed in the corners of the pond. These deposits were not picked up in sludge sampling due to their placement. It is clear that the mid and lateral-mid sections of the pond have been cleared of sludge and the remaining corner pockets are responsible for the COD plateau at 100 mg/l. With the ongoing dosage of the SA product these deposits will be oxidized and the COD and NH4+ values will drop to below the DWAF limits.

The Following Benefits Accrued From This Field Trial:

- Due to the oxidation of pollutants, the wastewater and effluent can be brought to within DWAF limits for release into receiving waters in approximately 12 weeks. This figure may be manipulated by the addition or subtraction of product quantities.
- This bioremediation takes place in situ with NO additional mechanical intervention, therefore no capital investment in plant expansion, machinery, or energy is required.
- This bioremediation takes place in situ with NO chemical or enzyme intervention; therefore no additional pollutants are introduced.
- Odors are eliminated within approximately one week after initial inoculation of product.

- The action of the bacteria consortium has as an additional beneficial side effect. Due to the reduction of odor, there was a reduction of the mosquito and fly population.
- As the sludge is oxidized the current extremely expensive cyclical dredging of ponds is reduced to an absolute minimum, if required at all.
- The contamination of groundwater is also remediated over time, as the anaerobic constituents of the bacteria consortium will permeate the soils with the pond water, thereby reducing the need for re-lining of ponds.
- As a result of treatment, the pond is in a state where fauna such as indigenous fish or others may be introduced. With a small investment in facilities, the area could be used for public recreation such as picnics, angling, bird watching etc.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS13113

California City Reduces Lift Station Maintenance with MICROBE-LIFT® Technology

Location: **Kerman, CA, USA**

Background:

A city of 14,000, Kerman is located 15 miles West of Fresno, CA. As the business and commercial center for Fresno County, this city was cited as one of the fastest growing cities in central California with 150% growth since 1990. Typically, fast population growth puts a strain on local services and the town's sewer maintenance was no exception.

Kerman's collection system is relatively new with approximately seven years of service to date. It consists of 25 grease traps in the city leading to 2 lift stations. The lift stations empty into five ponds before reaching a final 48 MG pond that is utilized to irrigate silage crops.

Objective:

The grease traps and lift stations were plagued with rapid grease build-up requiring expensive and time-consuming pumping and disposal of grease in most locations.

The wastewater manager stated that he had worked for the city of Kerman for 15 years and although he had "tried everything" he had never seen a technology that worked to clear the grease.

Ecological Laboratories' technical staff developed a program to treat the system with MICROBE-LIFT®/IND beginning with the two final lift stations. The first station was 10 X 15 X 35 feet deep with an auger to keep the fluid mixed. The second was 8 X 20X 30 ft deep. At the time of treatment there was a grease layer 2-3 feet thick covering the width of the station and extending over three-fourths of its length. The grease was physically removed from the well prior to initiation of treatment.

Initially both the wastewater and collection wells were each dosed once with 3 gallons of MICROBE-LIFT®/IND. Thereafter 1 gallon was added to the collection pit daily for four days. Starting on the fifth day, the system was maintained on a dosage of 1/2 gallon per week.

Results Achieved:

The results of treatment with MICROBE-LIFT®/IND were dramatic as depicted by the pictures below. Before treatment on February 8, 2012 the lift station pictured below was heavily impacted with grease and scum.

Fig. 1: *With the grate open, a 2 - 3 foot grease layer is evident prior to treatment.*

Fig. 2 & 3: *These pictures show a side view with gate open and a top view with gate closed.*

Fig. 4: *May 18, 2012 after three months of treatment, the grease cap has not returned.*

Fig. 5 & 6 *These pictures further demonstrate the lack of new buildup of the grease cap when seen from a side view and through the grate from the top.*

After three months with only the maintenance dose of ½ gallon per day being applied, the grease layer has not returned.

The MICROBE-LIFT® program was considered to be such a success that the wastewater manager is budgeting for the treatment program to be expanded to include all grease traps in the city system plus the sewer plant head-works.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS13114

Bioaugmentation with MICROBE-LIFT® Technology Reduces Sludge Production 20% Allowing Digester to Handle Increased Load

Location: **City of Busan (formerly Pusan), South Korea**

Background: Busan is the second largest metropolis in South Korea. With a population of 3.6 million, it is second in size only to Seoul. With rapid urban development the city of Busan was continually challenged with increasing wastewater treatment demand. The city's anaerobic digester was only functioning at 70% of design efficiency based on volatile suspended solids (VSS) reduction.

Objective: In 1999, Ecological Laboratories was approached by the City of Pusan in Korea about the use of one of it's bacterial products to improve the efficiency of it's anaerobic digestors, which were functioning at 70% of design efficiency based on volatile suspended solids (VSS) reduction. While a version of the product had been used in septic tanks, primarily an anaerobic environment, with good success, the product had not been applied to commercial size anaerobic digestors.

Pilot studies were conducted in 5,000-liter pilot reactors that remained from the original design work on the digestors. With encouraging results achieved in the pilot trials, field trials were later pursued.

MICROBE-LIFT®/IND Application Program

Day	Tank 1	Tank 2	Tank 3	Tank 4	Total
1	6 gal.	4 gal.	3 gal.	4 gal.	17 gal.
4	6 gal	4 gal.	3 gal.	4 gal.	17 gal.
7	3 gal.	2 gal.	1.5 gal.	2 gal.	8.5 gal.
10	3 gal.	2 gal.	1.5 gal.	2 gal.	8.5 gal.
13	3 gal.	2 gal.	1.5 gal.	2 gal.	8.5 gal.
16	3 gal.	2 gal.	.5 gal.	2 gal.	8.5 gal.
19	3 gal.	2 gal.	1.5 gal.	2 gal.	8.5 gal.
22	3 gal.	2 gal.	1.5 gal.	2 gal.	8.5 gal.
25	3 gal.	2 gal.	1.5 gal.	2 gal.	8.5 gal.
28	3 gal.	2 gal.	1.5 gal.	2 gal.	8.5 gal.
31	3 gal.	2 gal.	1.5 gal.	2 gal.	8.5 gal.
34	3 gal.	2 gal.	1.5 gal.	2 gal.	8.5 gal.
Maintenance (2x/wk)					
	1.5 gal.	1 gal.	0.5 gal.	1 gal.	

Total first 37 days = 127 1/2 gallons
Annual Maintenance = 416 gallons

Fig. 1: *This table provides the dosage schedule for the Busan field trial. The annual maintenance rate is 416 gallons.*

Results achieved: Within 90 days the VSS reduction went from 70% of design efficiency to 130% of design efficiency. The plant has continued to use the product with the exception of one year during which an alternate product from a Japanese supplier was used and the plant efficiency returned to the 70% VSS reduction efficiency observed prior to the bioaugmentation with MICROBE-LIFT®/IND. The following year when the MICROBE-LIFT®/IND was again added, the digestors again resumed the 130% VSS reduction observed the first time with the MICROBE-LIFT®/IND.

Fig. 2: *Harbor in Busan, South Korea*

For more information on MICROBE-LIFT® Technology contact

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CS13115

Shoal Lake Lagoon Treatment with MICROBE-LIFT® Technology Ensures Rapid Start-up in Spring After Winter Freeze

Location: **Shoal Lake, Western Manitoba, Canada**

Background: Shoal Lake is a small town of less than 1,000 people in western Manitoba. The wastewater generated by the town is treated in a series of three aerated facultative lagoons to lower key pollutant discharge parameters prior to discharge to the lake. The lagoons are in series and referred to as Cell #1, #2, and #3. Cells #1 and #2 are both 49 years old with a surface area of 5 acres and a depth of 6 feet with an approximate volume of 10 million gallons (MG). Cell #3 has been in service for 26 years and is 7 acres by 6 feet deep with an approximate volume of 14 MG. Normal inflow into the series of lagoons is approximately 0.22 million gallons per day (MGD). There is an estimated 2 feet of sludge in each lagoon. This sludge build-up reduces the working volume of the lagoons and the hydraulic retention time (HRT) of the system by about 30%.

Before the winter weather arrives, the lagoons are pumped down so that water can be collected during the winter months when no water is discharged. When the warmer weather arrives in the spring, water is discharged to the lake from the 3rd Cell after the water has been shown to be below discharge limits. The city's permit requires that the following parameters be met before discharge: BOD <30 mg/L; fecal coliform count <200 per 100 mLs. of sample based on the MPN Index; total coliform <1,500 per mL of sample based on the MPN Index; and total phosphate <1.0 mg/L. The lagoons also must keep offensive odors minimized.

Fig. 1: *Shoal Lake and lagoon system*

Since the biological activity slows down dramatically while the load is continually fed to the system over the winter months, it is desirable that the biological activity increases as quickly as possible in the spring to take advantage of the time frame when ambient temperatures are warm enough to effect adequate treatment.

Objective: In 2012, the city made the decision to evaluate a biological additive that would increase the biological activity quickly to achieve high levels of treatment as soon as possible. Samples for key operating parameters commonly monitored for wastewater discharge were taken monthly to effectively monitor the system efficiency. These included: BOD, COD, TSS, TKN, ammonia, nitrite, nitrate, total and reactive phosphorous, and total and fecal coliform counts. The additive evaluated was MICROBE-LIFT® formulation, produced by Ecological Laboratories, Inc. in Cape Coral, FL and supplied by Gerald Wiebe and Associates, of Manitoba. This product has been used successfully worldwide to improve the efficiency of biological systems, including lagoon systems, producing a high quality effluent and at the same time reducing odors, and breaking down organic sludge that has built up on the bottom of the lagoon resulting in significant overall cost savings.

CELL 1

Limited historical data on this system was available. More comprehensive monitoring was performed this year in order to better evaluate the impact of the bioaugmentation program. Performance of the individual Cells was monitored. The primary wastewater monitoring parameters for Cell #1 can be found in Figure 2.

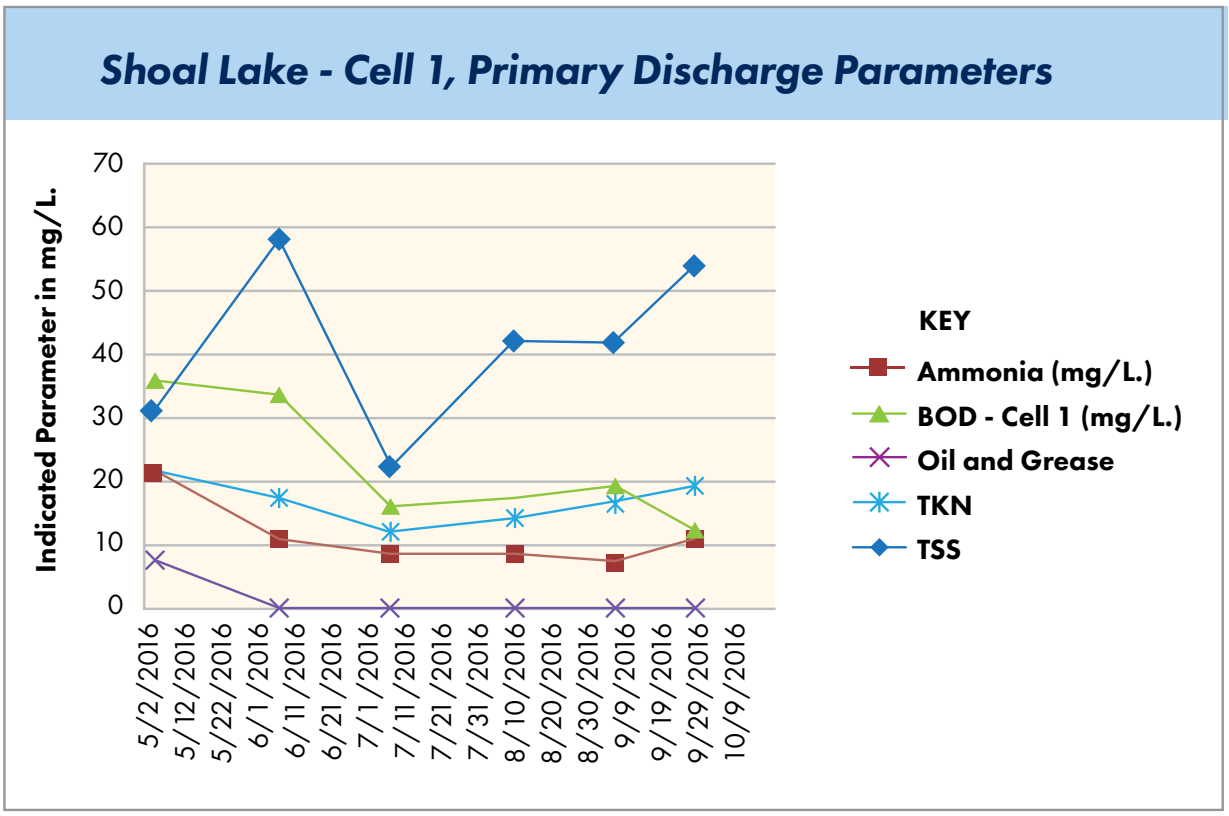

Fig.2: *Operating results for Shoal Lake Cell #1.*

The most dramatic drop was observed in BOD from the May through July time frame, with a total reduction of over 50% to below 20 mg/L. Similar results were observed with ammonia, TKN, and oil & grease. The only parameter, which increased was the TSS, which is to be expected as the bacterial population grows to handle the organic load. However, once their source of substrate was depleted, or stabilized, a drop in the TSS was observed in July. A later increase in TSS was likely due to the bacteria beginning to digest the accumulated organic solids in the lagoon bottom as a food source.

The nutrient analyses for Cell #1, which appear in Figure 3, show negligible levels of nitrites and nitrates throughout. It is possible that the primary mechanism for ammonia reduction, this early in the application, is a result of heterotrophic uptake of ammonia as a source of nitrogen for Cell synthesis. This is supported by the initial increase in TSS. Reactive phosphorous was also reduced, and again the probable mechanism is heterotrophic uptake to meet phosphorous requirements of the bacterial growth. The slight increase in total phosphorous is likely due to breakdown of biological solids on the bottom of the lagoon, but it should not be as great a concern since the non-reactive fraction of the phosphorous is less likely to create water quality issues like algae blooms.

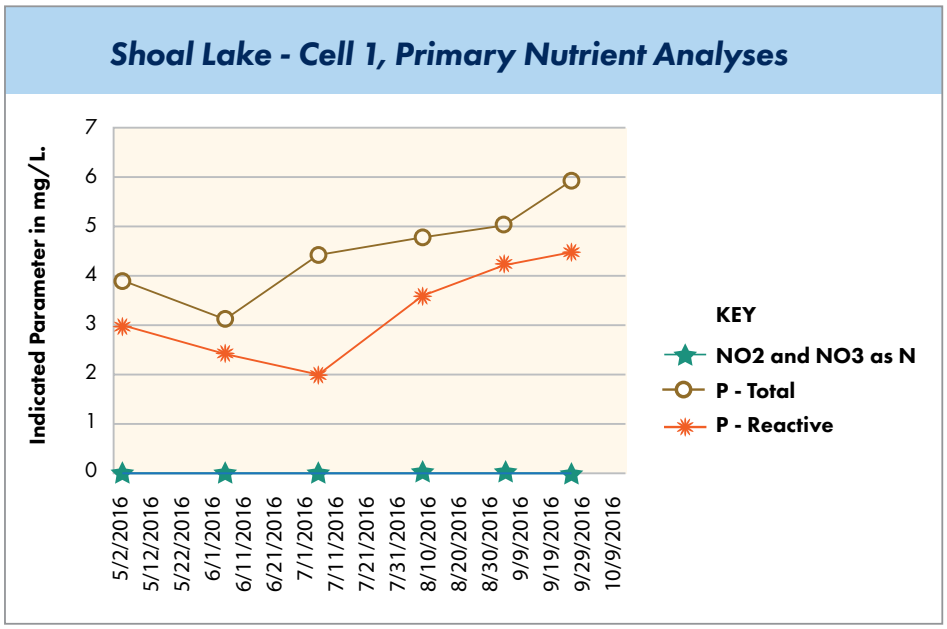

Fig. 3: *Shoal Lake Cell #1 Nutrient Data*

Total and fecal coliform numbers vary. The total coliform numbers generally increase as the temperature rises and more biological activity is observed. In general, the application of MICROBE-LIFT® technology will typically result in significantly reduced fecal coliform counts. It is possible, depending on the test methods used, that certain organisms in the MICROBE-LIFT® technology can generate a false positive for a time, but can be confirmed as not coliforms through additional testing. Since these numbers are observed in Cell #1 these numbers are not as great a concern since this water is not discharged directly to the lake, but goes to Cell #2.

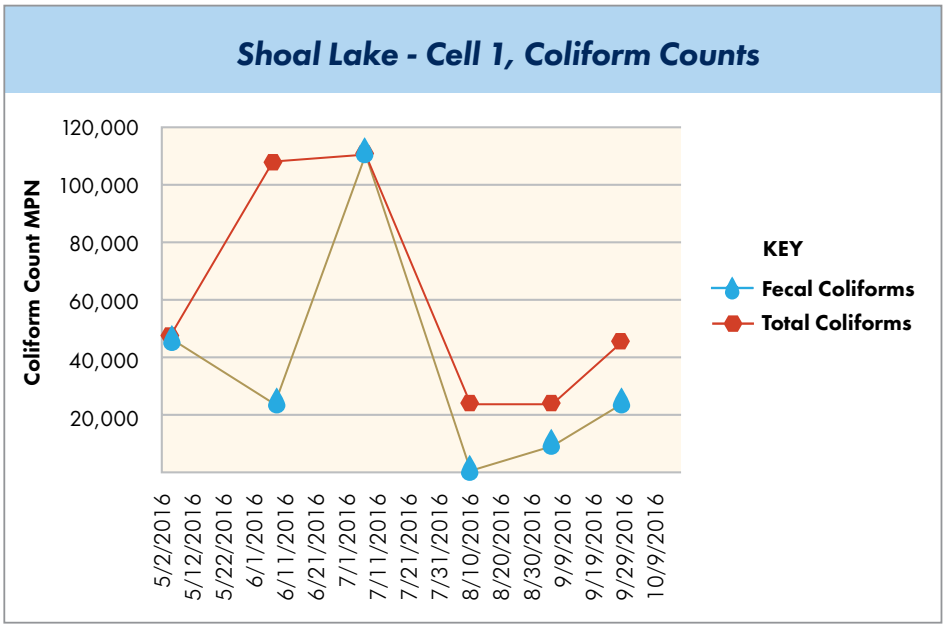

Fig. 4: *Shoal Lake, Cell #1 Coliform Data*

CELL 2

Proceeding to the primary discharge data in Cell #2 (Figure 5), all parameters with the exception of BOD have been reduced significantly. The BOD has risen slightly, and this is something that has been observed in many lagoon applications worldwide. This increase is due to the breakdown of solids that have accumulated on the bottom of the lagoon once the soluble organics have been lowered significantly. In documented cases, it has been demonstrated that from 1" to 3" of organic solids, which have accumulated on the bottom of a lagoon, can be digested per month. This usually results in substantial savings in dredging costs.

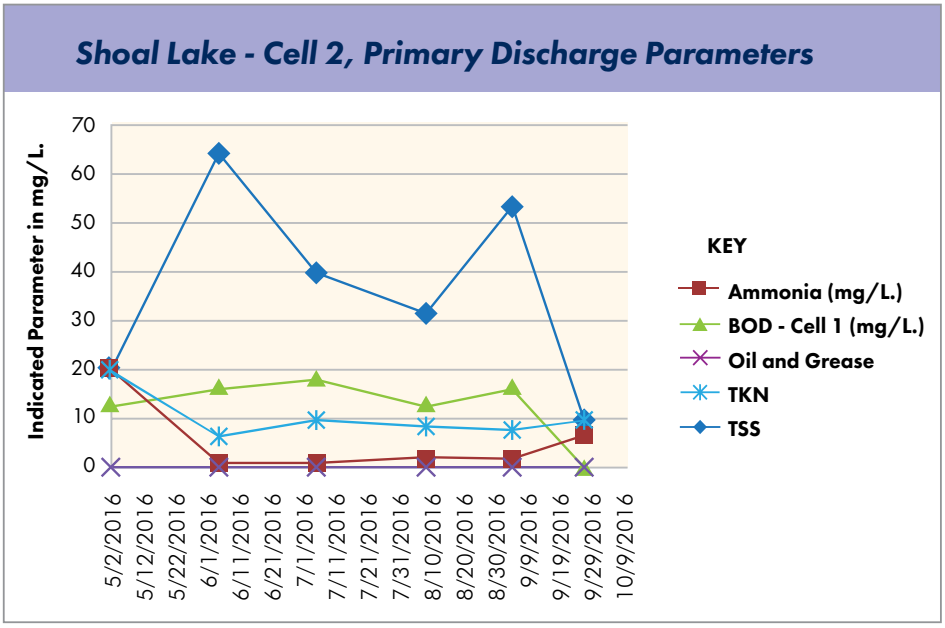

Fig. 5: *Operational results for Shoal Lake Cell #2*

Nutrient levels (Figure 6) show that nitrite and nitrate levels continue to be very low. Total and reactive phosphorous are somewhat higher but the more important reactive phosphorous being reduced to almost 1/0 mg/L. There will be less heterotrophic uptake of nutrients as the organics are reduced as a result of removal in Cell #1.

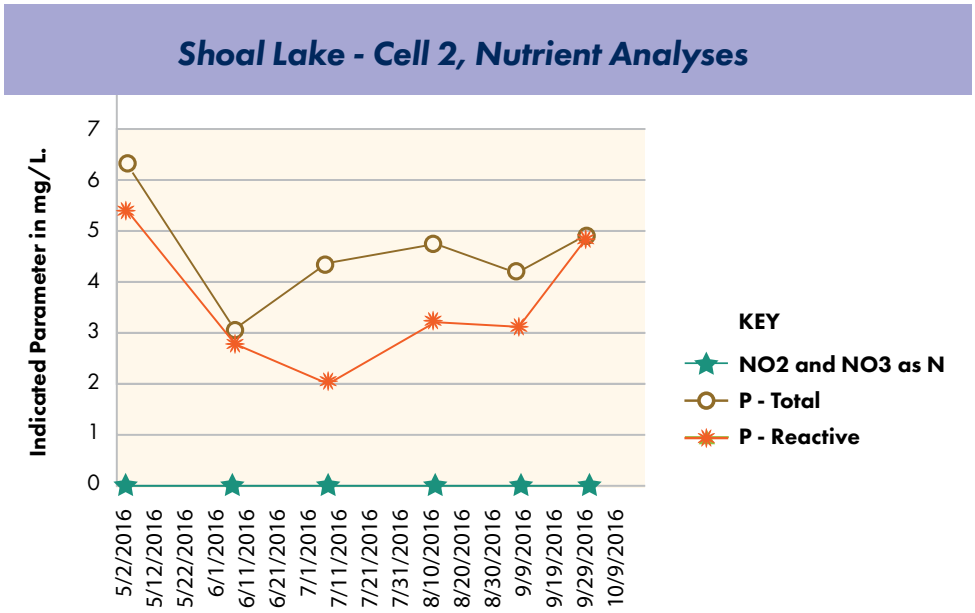

Fig. 6: *Shoal Lake Cell #2, nutrient data*

Coliform numbers for Cell #2 are much lower, as the populations in the MICROBE-LIFT® formulation compete with the naturally occurring coliforms for available nutrients. The increase in total coliform count in July may again be attributable to some false positive reading of certain organisms in the MICROBE-LIFT® formulation due to their versatile metabolic capabilities.

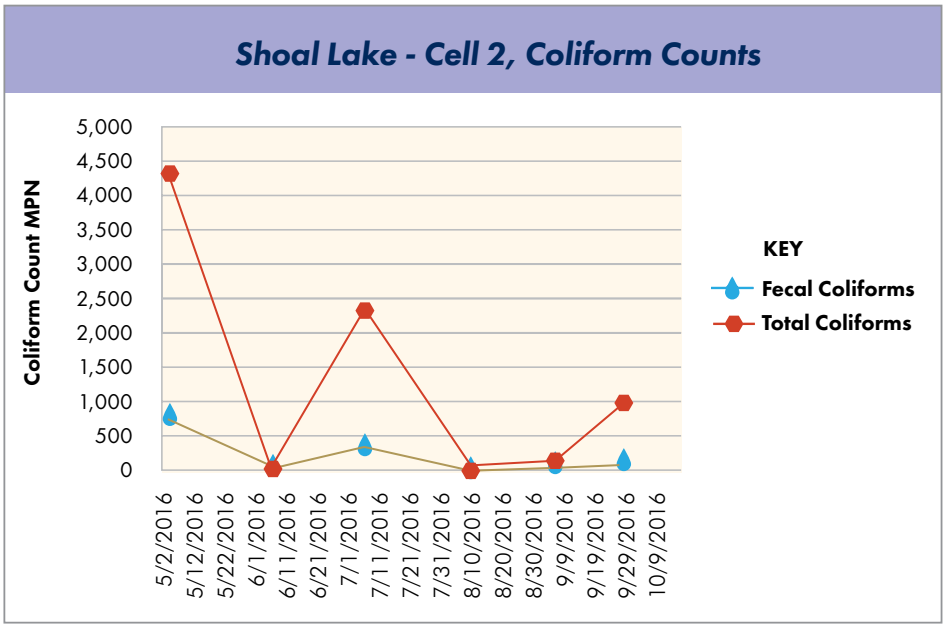

Fig. 7: *Shoal Lake #2 Cell coliform counts.*

CELL 3

In Cell #3 the primary discharge levels have been reduced, with the exception of TSS. All permitted discharge parameters have been reduced to below allowable discharge limits for most bodies of water. Our experience shows that most lakes will have background levels below what is observed here. Again, there is a slight rise in TSS values, as the beneficial bacteria multiply in the process of breaking down the organic pollutants. Eventually, the equilibrium levels of organics will be reduced to a level where the bacteria will go into endogenous respiration and the TSS levels will drop.

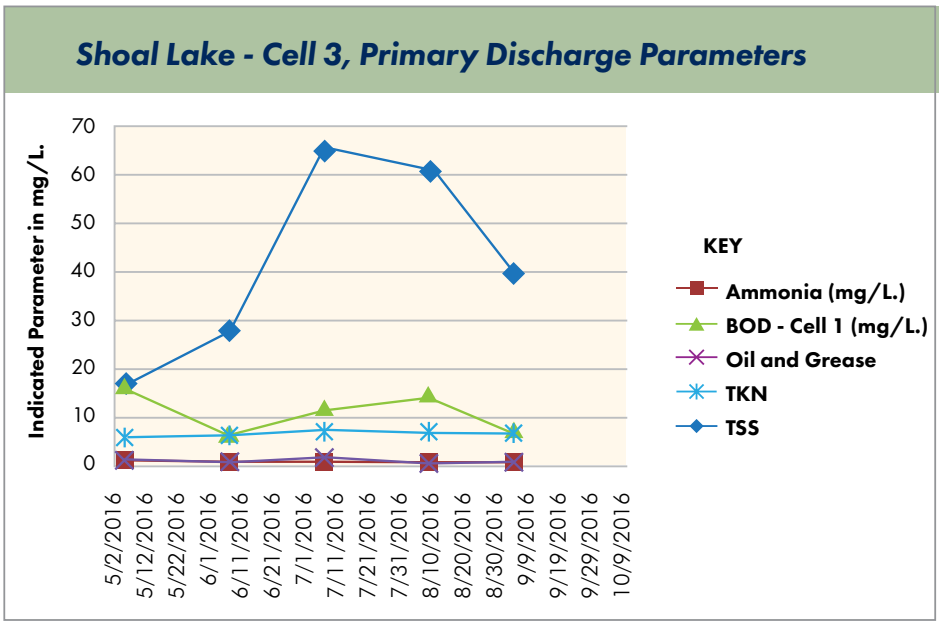

Fig. 8: *Shoal Lake Cell #3 performance data.*

There were no detectable results for nitrite and nitrate reported for Cell #3. The reactive phosphorous levels did decline but then rose slightly, while total phosphorous levels remained mostly unchanged. Fecal coliform levels in Cell #2 were 4 per 100 mls. Total coliform reading remained somewhat higher, but was still at a relatively low level for a natural body of water and is well within permit limits.

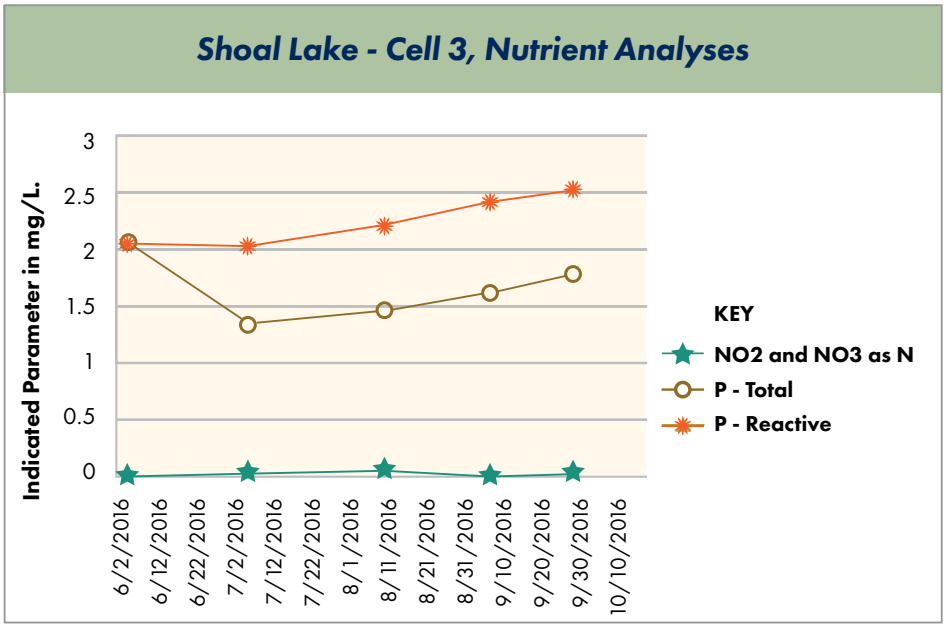

Fig. 9: *Shoal Lake Cell #3 nutrient analysis shows adequate levels.*

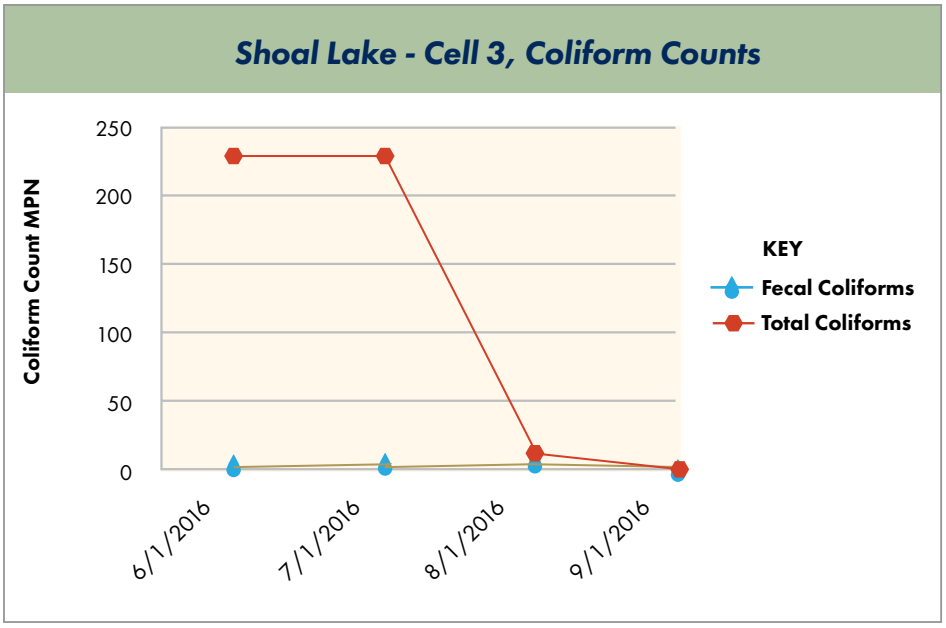

Fig. 10: *Shell Lake Cell #3 coliform data.*

Total Findings:

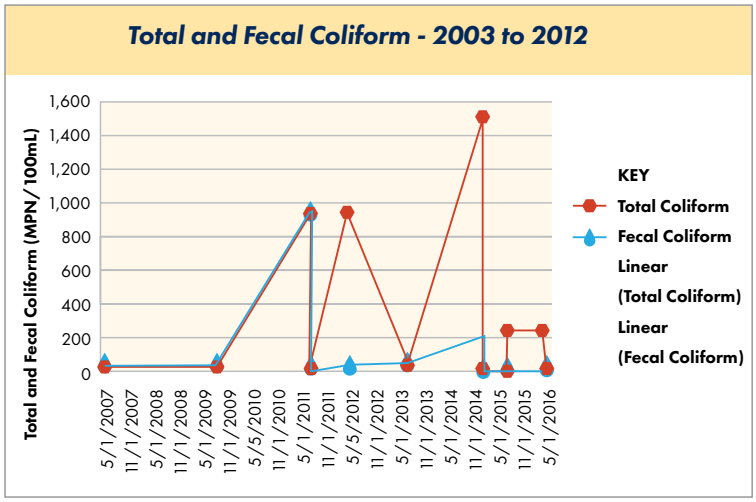

Fig. 11: *Total phosphorus readings compared for 2011 and 2012.*

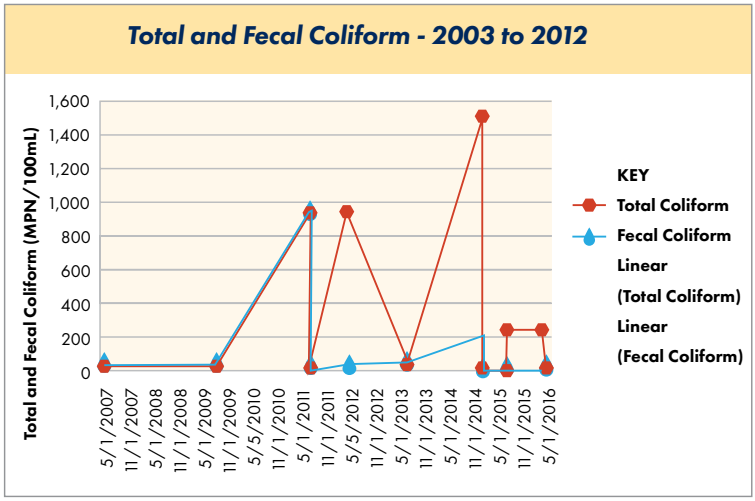

Fig. 12: *Total and Fecal Coliform Counts with projected trend lines.*

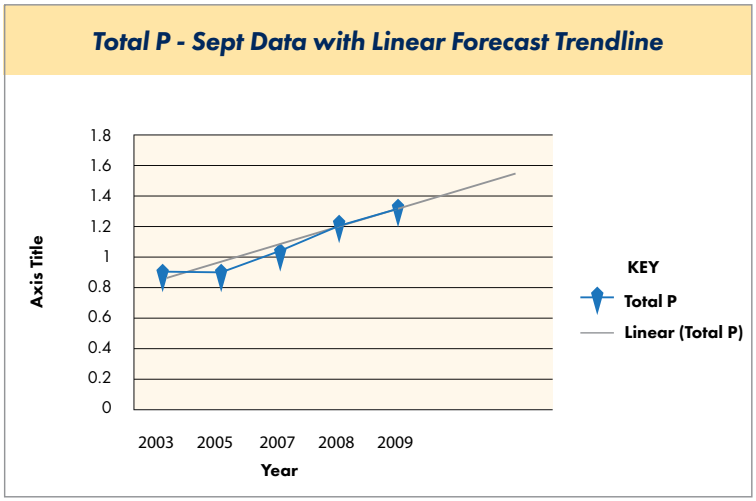

Fig. 13: *Historical September total phosphorous readings from 2003 through 2009 with projected trend lines.*

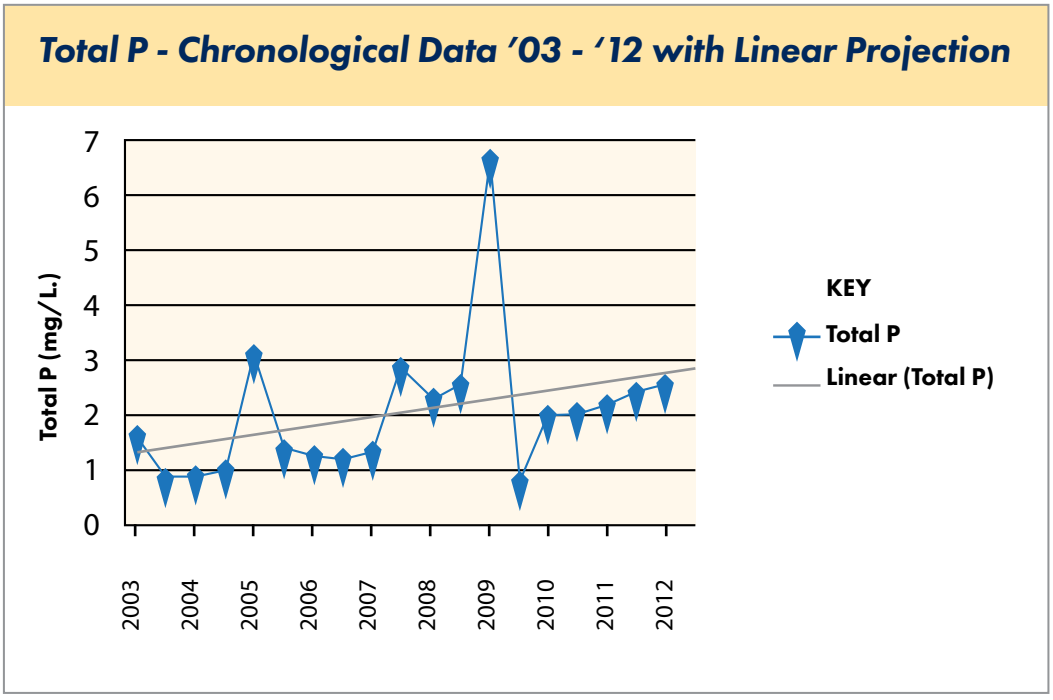

Fig. 14: *Chronological sequence of all total phosphate readings for Cell #3 from 2003 through 2012 with Linear Projection line*

Conclusions:

While comparisons of historical performance were limited, for certain parameters comparisons were made for performance data from 2012 relative to that of 2011. In addition, total phosphate data and coliform data trends were evaluated for all years for which data was available from 2003 to 2012. All significant discharge parameters were reduced over the monitoring period evaluated. As would be expected, there is some variability in the data from month to month and Cell to Cell. However, trends across the board for BOD, ammonia, TKN, O&G, nitrate-nitrite, are down. TSS values increased during monitoring, and, as pointed out earlier, this is to be expected due to increases in the biological activity and growth of the bacteria on the organics.

While slightly higher total phosphate values were observed, the historical values for total phosphate showed that there has been an increasing trend since 2003, possibly due to accumulation of bottom solids and release of phosphorous from the solids as they break down. During the trial period the phosphate levels were stable and did not exhibit the fluctuations observed in historical monitoring periods.

In the historical data presented, there was one occasion where the discharge limits for both total and fecal coliforms were exceeded, and there were marked fluctuations in readings. Compared to historical values, the coliform data observed during the trial period were much more stable and in a range where the values were substantially below discharge requirements, making an excursion very unlikely.

While only subjective qualitative observations were made regarding odor, the control of which is mandated in the permit, the general consensus was that odors were reduced and no complaints regarding odors were reported.

Recommendations:

The analytical results recorded during the bioaugmentation trial indicate that better system efficiency and stability has been observed and we propose continuing the program in 2013. This will provide further data with respect to the improvements in efficiency and stability.

Based on observations in other lagoon systems, in the future it would be helpful to monitor bottom solids levels to determine what level of solids breakdown we are achieving. It was estimated that there are two feet of sludge in all three lagoons. Additional loading from sludge breakdown effects many of the monitoring parameters. Considering the impact that the breakdown of organic solids has on the water monitoring parameters like soluble BOD, COD, ammonia, nitrates and phosphates would help get a better picture of the impact of bioaugmentation on treatment.

Sludge data would also provide even more economic justification for the program as in many cases bioaugmentation with MICROBE-LIFT® technology has saved municipalities hundreds of thousands of dollars on dredging costs by biodegrading these solids and reducing the frequency of, or eliminating the need for, dredging.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
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CS13116

MICROBE-LIFT® Technology Speeds Compost Processing & Reduces Odor while Producing Higher Quality Compost

Location: **Enviro Grind Ltd, Pettigo Co., Donegal, United Kingdom**

Background:

Situated in South Donegal, Enviro Grind is a waste recycling company that has diversified into the reprocessing of organic waste streams. Enviro Grind operates an ABP Category 3 approved in-vessel composting facility and takes in feedstock including catering industry waste, pre and post food processing waste, fish and shellfish processing waste, some sludge material and green/garden waste.

Odor is often a problem in composting, but with the diversity of feedstock this was reaching a level where even the odor control technology employed on-site was ineffective. Recent growth in business had meant that the plant was also operating at full capacity and any change to the process was going to result in significant investment. Finally, being an ABP Category 3 site, any change to the process must not have a negative impact on the temperature profile of the process.

Objective:

In an effort to reduce odor being generated, Enviro Grind initiated a trial of MICROBE-LIFT® core technology. Enviro Grind applied the recommended dosage of bacteria directly to the incoming waste. With a broad spectrum of bacteria being introduced at the start of the process, the aim was expanded to not only reduce the odor, but also speed up the process to reduce the strain on capacity.

Results achieved:

Within the first six weeks of the program the performance was reviewed and due to the obvious odor reduction, Enviro Grind agreed to continue use for a prolonged period. After a year of use the results are clear:

- Odors are significantly reduced.
- Organic breakdown is improved.
- The operation process has been stabilized.
- The compost is dryer, and, as a result, screening is easier.
- All of the above have led to an increase in capacity.

Most importantly, all this has been achieved without any negative impacts on the process, or output, that could affect the ABP Category 3 status.

Martin Eves, Managing Director of Enviro Grind comments: "The addition of the MICROBE-LIFT® technology product has removed inconsistencies from the active composting phase, thus reducing processing time and improving the quality of compost produced". For more information on Enviro Grind Ltd, visit www.envirogrindltd.com or call +353 7198 61772.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.
www.EcologicalLabs.com

CS13117

Made in the USA

Odor & Solids Reduction at Wastewater Treatment Plant on Resort Island in Southeast Georgia

Location: **WWTP on Resort Island in Southeast Georgia**

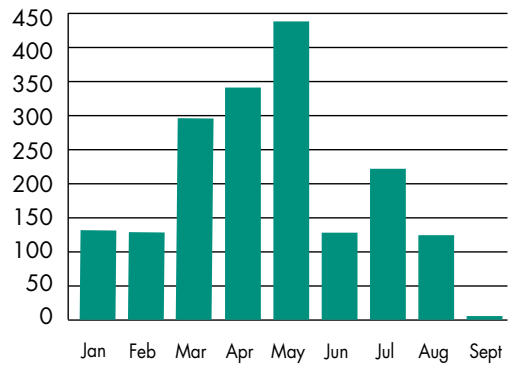
Problem: A WWTP in Southeast Georgia located on a resort island has a 3 million gallon per day flow. The WWTP was experiencing major odor problems at the head of the plant, as well as poor digestion and settling of bio-solids in the SBR's and aerobic digesters. The odors were primarily H_2S and were the source of numerous complaints from the residents living in the vicinity of the WWTP. The plant was hauling and disposing an average of 125 to 150 tons of bio-solids per month at a cost of approximately $60 per ton, which equates to $7,500 to $9,000 total average hauling/disposal charges per month.

Solution: MICROBE-LIFT®/IND was added to the influent of the wastewater stream approximately 100 yards before the head of the plant. The product was added at a rate of 3-4 PPM of the daily flow (3 million gallons). Odors were immediately reduced at the head of the plant. Within 2 days the plant operator began to see a significant reduction in solids in the SBR's as well as the digesters.

The WWTP was treated for a period of 30 days at a rate of 3-4 PPM. The plant operator also added 2.5 gallons of product directly into the digesters each day.

Results: During the first month of treatment the odors being generated at the head of the plant were dramatically reduced. No odor complaints from the residents were received during first month of application. The total waste solids for the 30-day period were reduced from an average of 125 tons to 4 tons (96.8% reduction). The plant saved $7,260 in hauling/disposal expense during the month. The improvement in overall plant operation also allowed for fewer man-hours being needed to run the plant.

Municipal WWTP Bio-Solids Tons Waste



MICROBE-LIFT®/IND feed at a rate pf 3 PPM during the month of September. Saved WWTP $7,000 in hauling and disposal fees.

For more information on MICROBE-LIFT® Technology contact

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CS13118

Made in the USA

Sludge Reduction & Cost Savings at Sequential Batch Reactor Plant in Southern Pennsylvania

Location: **SBR Plant in Southern Pennsylvania**

A 0.5 mgd SBR plant in southern Pennsylvania uses **MICROBE-LIFT®**/IND and **MICROBE-LIFT®**/OC and achieves the following improvements:

1. Maximizes throughput from aerobic digester to sludge press. If the digester gets full, they cannot remove waste solids from the SBR basins.
2. Reduces foaming in aerobic digester so blowers do not have to be turned off
3. Reduces filter press downtime for cloth washing
4. Decreases time and manpower requirements for the above-mentioned cleaning
5. Reduces chemical costs for filter press
6. Improves the effectiveness of UV disinfection
7. Makes it possible for primary contributors to increase their discharge flow to the WWTP facility
8. Makes it possible to operate plant at lower MLSS thus reducing foaming and filamentous
9. Better decant is possible in winter due to no frozen foam on decant trough
10. Net savings of over $2,000 per month

Background

Plant personnel wanted to lower operational costs if possible but maintain good effluent quality. Also, foaming was a problem throughout the system. Aerobic digester blowers often had to be turned off due to excessive foaming, so the aerobic digesters, in effect, became anaerobic digesters. This resulted in the production of solids that settled poorly and were difficult to dewater and in the generation of filamentous bacteria. Foaming at the surface of the two SBR basins was not only unsightly, but it was a breeding ground for filamentous bacteria, and, when foam froze during winter months, decant trough function was impaired.

Initial evaluation of **MICROBE-LIFT®**/IND and **MICROBE-LIFT®**/OC had the following **objectives:**

A. Improve B.O.D. removal to reduce foaming organics
B. Reduce the quantity of sludge generated
C. Improve solids settleability and dewaterability
D. Improve plate-and-frame filter press performance, while lowering flocculation-aid chemical usage
E. Reduce operational costs

Results: Before and After Comparisons

I. Aerobic digester blowers often had to be turned off because high levels of foam were generated and even overflowed the tank. An unavoidable consequence of this was that within minutes, anaerobic conditions would develop within the aerobic digester. This not only encouraged filamentous growth, but also resulted in significant solids deterioration. Solids in such a case do not settle well and are difficult (and expensive) to dewater.

IND and OC were added to the digester and within days **foaming was dramatically reduced** and blowers could be left on as per design specs.

II. Loading and flow conditions were the same before and after treatment with IND and OC began. Along the same lines, the average number of gallons of sludge waste per day from the two SBR basins did not change significantly. These factors are significant.

> In the 12 months before treatment began, an average of 27,810 gpd total was waste.
> In the first 12 months after treatment started, daily average wasting was 27,572 gpd.
> This is a difference of only 238 gpd. Therefore, the performance improvements **and cost savings achieved was NOT due simply to fewer gallons per day being waste.**

III. Since it had been observed that **foaming** was much more severe **on the SBR basins** at higher mixed liquor concentrations, there was incentive to reduce MLSS—but without decreasing plant performance or effluent quality. Specifically, they did not want to affect nitrification.

> In the 12 months before treatment began, average MLSS (of both basins) was 2,843 mg/lit.
> In the first 12 months after treatment began, average MLSS was 2,580 mg/lit, **down 263.**
> (Update: MLSS's can now be carried as low as 2000—and with improved performance.)

At these lower mixed liquors, foaming was appreciably reduced, protozoal population was "younger," and biological floc settled (and dewatered) better.

IV. With new cloths, the **plate-and-frame filter press** could get 90 runs/cycles/dumps between washings. Washing the cloths is an unpleasant, manpower intensive, ergonomically unfriendly task—not to mention that cake quality deteriorates as you get closer to the limit of the runs.

Except with new cloths, the average number of runs between washes was 32. After treatment with IND and OC began, **average number of days between washings went up to 110.** Press cake was higher quality as well. Better removal/degradation of fats, oil, and grease by the microorganism in IND and OC is the primary reason press performance is improved.

V. Sludge cake is transported to landfill where it **is weighed.**

Average monthly weight of this sludge cake **before** treatment with IND and OC:

155.4 Tons/month

Average monthly weight **after** treatment began:

60.2 Tons/month

This represents a 61.3% reduction in the amount of sludge cake disposed of per month on average

VI. Aluminum chlorhydrate (coagulant) cost reductions:

Before treatment: **15,648 gallons used in 6 months**
After treatment: **10,876 gallons** used in the corresponding 6 months

This represents a **30.5% reduction** and very considerable **cost savings** at $4.33 per gallon. **($21,000.00)**

VII. A UV array is used at this plant for **disinfection** of final effluent. The higher the transmittance of UV rays, **the better** the disinfection.

Before treatment: average transmittance was **23%**
After treatment: average transmittance was into the **mid 40%** range, a near doubling.

VIII. The above-mentioned improvement in UV transmittance made it possible for the WWTP to **lift** the **cap on the leachate flow** it received from the local landfill when necessary (after heavy rains, e.g.).

Before treatment: **35,000 gpd 6 days a week** was the limit on the landfill leachate flow
After treatment: **50,000 gpd 7 days per week if necessary**

Note: The landfill leachate has a tint to it. This was the original reason for the daily cap on flow from the landfill. Please note that the improved UV transmittances reported in Point VII above occurred even in light of the increased flows from the landfill reported in Point VIII.

IX. Net savings for this 0.5 gpd plant was an average of **$2,200 per month**, excluding reductions in manpower costs (for press fabric washings). Dosage of **MICROBE-LIFT®** /IND is 3 gallons per week. Dosage of **MICROBE-LIFT®** /OC is also 3 gallons per week. Addition point was directly into the aerobic digester for 3 months to seed it, then to the headworks thereafter.

For more information on MICROBE-LIFT® Technology contact
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CS13119

14200 PETROLEUM REFINERIES & SOIL REMEDIATON CASE STUDIES AND TESTIMONIALS

14201	A Major Oil Company in Hong Kong Remediates Subsurface Hydrocarbon Contamination with MICROBE-LIFT® Technology
14203	Successful in Situ Remediation of Hydrocarbon Contaminated Soils in South Africa
14204	MICROBE-LIFT® Technology Cleans Up Petroleum Lagoon in Israel
T14205	Effectiveness of MICROBE-LIFT® Bacteria Mixture in Bioremediation of Petroleum Contaminated Soils at Mostardi-Platt Plant
T14206	Compliance Environmental Confirms PCB Transformer Oil Degradation in Bioremediation Test
14207	MICROBE-LIFT® Technology Helps Remediate TPH Contaminated Soils in Georgia and Tennessee

The case study results listed above were achieved with MICROBE-LIFT® Technology and products, formulated and manufactured by Ecological Laboratories Inc., with technical support for administering the products provided by Ecological Laboratories Inc., in support of their worldwide representatives.

For more information on MICROBE-LIFT® Technology contact

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CS14200

A Major Oil Company in Hong Kong Remediates Subsurface Hydrocarbon Contamination with MICROBE-LIFT® Technology

Location: **Oil Transportation & Transfer Site, Hong Kong**

Background: **Ecological Laboratories** has addressed wastewater technology internationally for over ten years. In that time they have remediated a variety of petroleum contaminated sites including oil production ponds in Venezuela for GEBetz, containment ponds in Israel, and sites in the Dominican Republic and throughout Asia. In this case, a major oil company, who chooses to remain anonymous, had detected contaminated soil under a concrete slab at an oil transportation and transfer site. The oil had seeped into the ground to a depth of two meters.

Objective: To avoid further mobilization, it was imperative to remove the oil by the most cost effective, least disruptive technology available. Working with their local agent, Ecological Laboratories developed a remediation plan using MICROBE-LIFT® technology.

Because in-situ treatment generally requires support engineering, it is important to first confirm that the hydrocarbon can be degraded by the inoculant and that the site does not contain additional toxicity that would inhibit biological activity. Therefore, a benchtop remediation trial was run using a soil bio-slurry inoculated with a MICROBE-LIFT® formulation.

This MICROBE-LIFT® formulation was applied to a slurry containing contaminated soil in a tank. Dry weight of material was 10-15%, pH 7-9, TPH content at 3-5%. The TPH was not diesel based, but made up of linear hydrocarbon chains between C12 and C20. The boiling point is between 200° and 250° C in the gas chromatographic analysis (C10-C40) giving the following splitting in mg/kg dm:

Hydrocarbon Fraction C10-C40 mg/kg Ds 43,400
Hydrocarbon Fraction C10-C12 mg/kg Ds 875
Hydrocarbon Fraction C12-C16 mg/kg Ds 21,375
Hydrocarbon Fraction C16-C20 mg/kg Ds 6,750
Hydrocarbon Fraction C20-C24 mg/kg Ds 2,475
Hydrocarbon Fraction C24-C28 mg/kg Ds 800
Hydrocarbon Fraction C28-C32 mg/kg Ds 400
Hydrocarbon Fraction C32-C36 mg/kg Ds 460
Hydrocarbon Fraction C36-C40 mg/kg Ds 300

The test tank contained +/- 600 liters in a slurry (+/- 75 kg waste+ 525 kg water). Nitrate was added to assure that proper C:N:P ratio for biological degradation was present. The slurry was re-circulated in order to provide adequate mixing. The initial test was run for 28 days. Each 7 days the slurry was sampled in order to follow the TPH content and the biodegradation.

A Major Oil Company in Hong Kong Remediates Subsurface Hydrocarbon Contamination with MICROBE-LIFT® Technology

Solution:

After three weeks the MICROBE-LIFT® formulation had reduced the petroleum by 71%.

MICROBE-LIFT® had readily degraded the contaminating TPH and there was no toxicity present that would prevent a successful remediation. The results of the study are shown below:

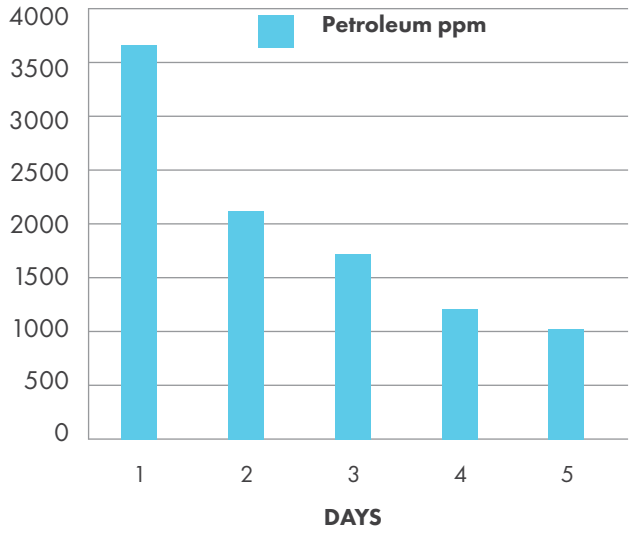


Fig. 1: *This graph shows the result of the bench top remediation with an initial concentration of 35-40,000 ppm of hydrocarbons C10 to C40 being reduced by 71% in one week*

Results Achieved:

The in–situ treatment was initiated. After drilling a test hole of two to three meters, a gradient-flow analysis was conducted. Diluted MICROBE-LIFT® was applied through injection holes and recycled through extraction holes downgrade to get the same results in the field. The site was successfully remediated. In our experience, all applications for in-situ remediation tend to be site specific depending on other contaminants present and engineering required providing adequate contact, but in general most land treatment plans require the following:

- Inoculation with capable consortium of microbes (pretesting recommended)
- Provision of the necessary nutrients (adjust C:N:P ratio)
- pH and moisture adjustment as necessary
- Assurance of contact between microbes and pollutants:
  1. Land farm surface pollution - work remediation ingredients into soil or
  2. Subsurface soils - provision of an engineered system, often pump and treat, to assure contact
- In some cases, a solubilizing agent such as a lipophilic surfactant may be recommended to increase surface contact.

Effective bioremediation is always the most cost effective solution for elimination of hydrocarbon contamination and it is widely used by industry globally. Ecological Laboratories' MICROBE-LIFT® technology, is a highly effective solution to hydrocarbon pollution when used with proper, site-specific application.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14201

Successful In Situ Remediation of Hydrocarbon Contaminated Soils in South Africa

Location: PepsiCo Frito-Lay Simba Isando, Gauteng, South Africa

Background: Use of the vehicle workshop area at the Frito-Lay Simba Isando plant was discontinued due to outsourcing of the distribution chain. An area in front of the wash bay borderedby the workshop and boundary walls had been heavily contaminated by hydrocarbon.This contamination was a mix of petroleum (PRO) and diesel (DRO) range organics and covered a surface area of approximately 300 square metres. The contamination occurred in three main areas, these being DRO in approximately 30 square metres under the removed diesel tank, a mix of DRO and PRO in approximately 120 square metres in front of the wash bay and an area of approximately 90 square metres of tar macadam covered soil. The wash bay area was contaminated with a mixture of petroleum, diesel,oils, alkanes and kerosenes. During initial sampling the average depth of contamination was found to be 150 mm below the surface, a target depth of remediation was set at 250 mm below the surface. In order to re-use this ground the company requested they 2000 mg/kg. This value was chosen based on the fact that the site was industrial and would not readily be used for agriculture or human occupation in the foreseeable future. Another factor affecting this target is that the Department of Water Affairs and Forestry (DWAF) had in the past recommended the use of a similar target for hydrocarbons in an industrial area (Snyman 1996). The area was completely enclosed by concrete walls on three sides and a brick workshop on the remaining side. Thus, in-situ bioremediation was the preferred method providing the following benefits:

- No expensive removal and replacement of the walls was needed,
- No removal and transfer of the contaminated soil would be required.
- No addi tional treatment system was required.
- No suitable dumping site with associated transfer and fees would have to be utilized.

Objective:

Due to environmental audits there was a need to bioremediate the soil in as short a time span as possible with a 12-week time span allocated. To create the most favorable conditions for a successful bioremediation of hydrocarbons in soil, a number of factors needed to be considered:

1. Product specifically manufactured for the bioremediation of hydrocarbons would be needed. MICROBE-LIFT® technology in the USA were selected based on proven efficacy and exceptional technical backup available from the producers of the product, **Ecological Laboratories**, based in Florida USA.

2. The soil needed to be regularly tilled to the depth of the contamination in order to aerate the soil providing the most suitable conditions for the growth of the bacterial colonies.

3. The Carbon:Nitrogen:Phosphate (C:N:P) ratio of the soil was tested and modified as necessary to provide optimal nutrient conditions for growth of the amended bacteria.

4. The soil was kept damp, but not saturated, to provide the most suitable environment for bacterial growth. Due to the limited time and budget available this was achieved with a manually set flow rate of water as opposed to control via measured moisture content.

5. The bioremediation products were dosed in a regular regime to provide a continuous replenishment of the bacterial consortium to the area being treated thus building the most effective bacterial population for the oxidation of the hydrocarbon compounds.

The above conditions were satisfied using the following method. Prior to the delivery of hardware and product, initial soil samples were taken as a baseline for the bioremediation and to ascertain the C:N:P ratio. An independent laboratory was used to analyse the soil samples. Two sampling areas were determined to provide an average value of contaminated soil and a control sample of uncontaminated soil. The soil samples were taken by extracting a plug of soil which was then placed in a sample jar, inverted and kept at constant temperature in a polystyrene container until delivered to the laboratory.

The soil was then tilled to a depth of 250 mm.

The initial values for the C:N:P ratio were given as 100:4:1 rounding to the nearest whole number. This value was deemed to be close enough to the required values of 100:5:1; therefore no fertilizer was added.

An irrigation system comprising 25 mm irrigation pipe was laid. This consisted of a delivery trunk main pipe running along the west wall for 0.10 metres. This trunk main was fed via a 1 kW water pump fed by a 60-litre drum. The drum was replenished from the water main using a regulator valve to maintain a constant volume of water in the drum. Five branch pipes were laid 2 metres apart, running at right angles from the trunk main eastwards across the contaminated area. Each 30 metre branch pipe was connected to the trunk via a tee piece and regulating valve. 360-degree irrigation spinners were fixed at 2 metre intervals along each branch pipe. This layout created an effective grid system of 2 metre squares fed from each irrigation spinner. The required flow rate of water was then manually set using the regulator valves.

Once the required flow rate was confirmed by monitoring the soil moisture content for two days, ½ kg of MICROBE-LIFT® formulation was spread evenly over the soil. This dosage of MICROBE-LIFT® formulation was repeated every 2 days from the inoculation date.

In order to dose the MICROBE-LIFT® formulation,12 litres of MICROBE-LIFT® formulation as an inoculation dose was poured into the 60 litre drum feeding the pump. The mains water inflow to the drum created sufficient turbulence to mix the product with the water. This mixed product was then pumped into the irrigation system and evenly distributed via the 360 degree spinners. A quantity of spare spinners was kept available for replacement of blocked spinners. These were replaced as and when required. A MICROBE-LIFT® formulation dosage of 4 litres was then repeated every 2 days from the inoculation date.

This dosing schedule ran for 44 days from 15 May 2010 to 28 July 2010. The total product utilized was 47kg of MICROBE-LIFT® formulation.

The soil was then tilled to 250 mm once every two weeks.

Results achieved: The table below gives the results of the laboratory analysis:

Date	TPH mg/kg Series 1	TPH mg/kg Series 2	% Reduction In contaminated soil
13th May 2010	17630	151	
8th June 2010	16012	701	9.2
9th July 2010	1684	402	89.5
28th July 2010	1681	1433	89.5

Fig. 1: *Series one is the contaminated soil while series 2 refers to soil not considered contaminated.*

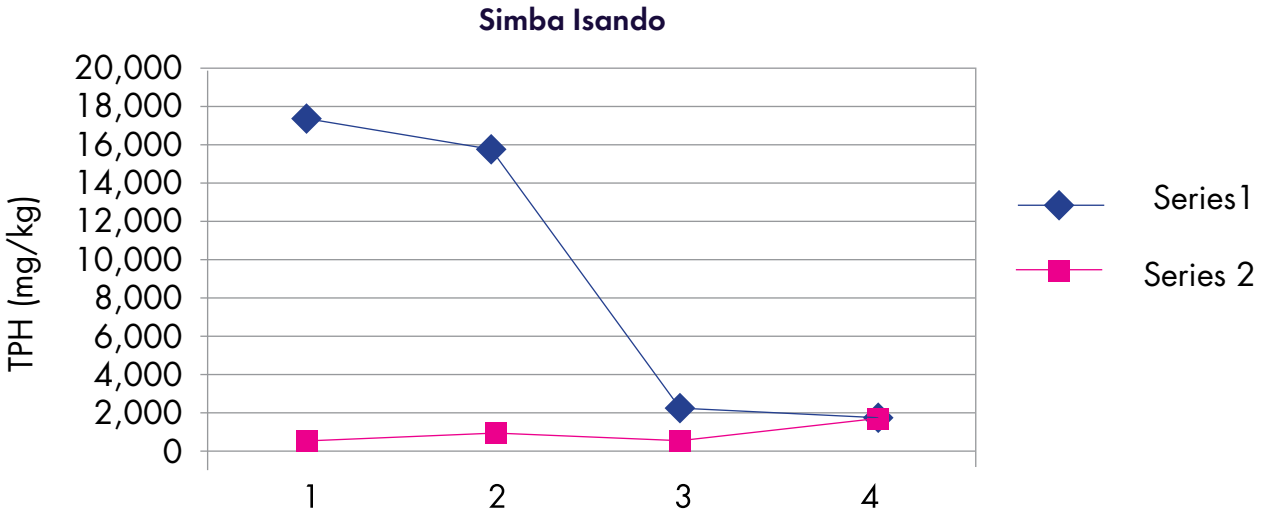


Fig. 2: *Shows the data represented graphically.*

Series 1 indicates that the contamination was reduced from an initial TPH value of 17630 mg/kg to 16012 mg/kg. This reduction occurred in the initial 3 weeks after inoculation indicating that the bacterial consortium from the MICROBE-LIFT® formulation has begun to take hold and multiply in the soil. The growth of the consortium reaches a peak in this period and begins to stabilize to a point where the bacterial colony has grown to a level where the colony/nutrient source is balanced and maximum oxidation of the hydrocarbons is in progress.

This oxidation process continues at this level for a period of 4 weeks until the nutrient content supplied by the hydrocarbons has been depleted to the point where the bacterial colony begins to die off in relation to the nutrient source.

During the final 3 weeks of the remediation the bacterial colony has once again reached equilibrium with the nutrient source, however at a much lower level. This is the expected outcome of the natural bell curve growth of organisms in the presence of a finite nutrient source.

Series 2 shows a small upward trend in the TPH value reaching approximately the same level of TPH value given by series 2. This upward trend is due to the action of the water/product mix creating an osmotic effect in the soil where some of the hydrocarbon contamination is spread throughout the treatment area. It is shown in the results that the target TPH value of 2000 mg/kg was reached and exceeded in 10 weeks with the final value being 1681 mg/kg. This is seen to be a reduction of 89.5%.

Conclusions: Despite the short time frame given for the bioremediation, the MICROBE-LIFT® formulation succeeded in remediating the hydrocarbon contamination. The required result of reducing the contamination to an acceptable level of 2000 mg/kg TPH was reached in 10 weeks, being 2 weeks shorter than the requested duration.

In short, **Ecological Laboratories** achieved a successful bioremediation using the method as proposed. MICROBE-LIFT® technology has proven its ability to degrade hydrocarbons in the DRO and PRO range.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14203

MICROBE-LIFT® Technology Cleans Up Petroleum Lagoon in Israel

Location: **Oil Company, Jordon Valley, Israel**

Background: Crude petroleum that had been collected from a transport spill was collected and deposited in a 100,000-gallon containment lagoon in the Jordan Valley, with the expectation that the petroleum would biodegrade over time.

Objective: After several months with little or no degradation observed, alternatives were evaluated to accelerate the petroleum breakdown. A recommendation was made to use bioremediation. After evaluating different microbial additives, **Ecological Laboratories** was contacted. **Ecological Laboratories** had utilized MICROBE-LIFT® technology very successfully in numerous petroleum clean-up applications.

Since the lagoon also contained municipal sewage there was adequate nitrogen and phosphorous present to provide the required nutrients for the petroleum degradation. In addition to the MICROBE-LIFT® formulation, FDG, a lipophilic surfactant, was applied to help solubilize the petroleum to make it more readily available to the microbes.

Fig. 1: *The lagoon was not a pretty sight with oil scum over the entire surface.*

Fig. 2: *A close-up picture shows the extent of the oil and scum in the lagoon.*

After inspection and evaluation of the lagoon, **Ecological Laboratories** developed a treatment plan as follows:

Day 1:	Add 300 mls. FDG (lipophilic surfactant) Plus 600 mls. MICROBE-LIFT® formulation
Every three days thereafter:	Add 70 ml FDG & 150 mls. MICROBE-LIFT® formulation

Fig.3*: Treatments were mixed with water and sprayed over the surface of the lagoon to provide maximum contact with the surface oil.*

Results:

After treatment, the water was dramatically cleaner with no visible oil scum on the surface.

The primary parameter for monitoring the crude petroleum breakdown was Total Petroleum Hydrocarbons (TPH). Other parameters tracked were Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Soluble COD, and Total Suspended Solids (TSS). Results from the outside lab testing of these parameters are shown below:

Initial, Pre-trial data (mg/l)				
BOD	COD	Soluble COD	TSS/TPH	TPH
1,900	12,900	268	55,427	25,000
After three weeks of treatment (mg/l)				
BOD	COD	Soluble COD	TSS/TPH	TPH
568	4,900	268	1,750	2,915
Percent removal in 3 weeks				
70%	62%		97%	88%

After three weeks of treatment, a reduction of almost 90% of the TPH was observed. While 60-70% reductions in BOD and COD were observed. The BOD numbers were likely artificially low due to the lack of the seed's acclimation to petroleum, which is known to inhibit microbial activity. Soluble COD did not change, due to that fact that as soluble COD is broken down more is solubilized by a combination of the added surfactant as well as biosurfactants produced by the bacteria. Generally, after all of the non-solubilized petroleum is solubilized and broken down, the soluble COD will drop to non-detectable levels.

Based on the three-week analytical data and physical observations, no further analytical testing was performed to save added cost as no more petroleum was observed in the lagoon. The initiation of the degradation had been confirmed.

This was another highly successful application for the degradation of petroleum oil.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14204

Effectiveness of Microbe-Lift® Bacteria Mixture in Bioremediation of Petroleum Contaminated Soils at Mostardi-Platt Plant

January 4, 1993

Ecological Laboratories, Inc.
P.O. Box 132
Freeport, New York 11520

Attention: Mr. Barry Richter, President

Gentlemen:

Effectiveness of Microbe-Lift Bacteria Mixture in Bioremediation of Petroleum Contaminated Soils

MOSTARDI-PLATT ASSOCIATES, INC. (MPA) has prepared this letter to inform you of the preliminary results of a controlled experiment involving the full-scale field application of Microbe-Lift for remediation of petroleum contaminated soils. In this experiment, four relatively uniform soil cells, with volumes of approximately 30,000 cubic feet each, were to be remediated by bioremediation. The contamination involved was a heavy fraction of petroleum.

Three of the four cells have been treated using an application technique developed by MPA that incorporates the Microbe-Lift bacteria mixture, and the remaining cell was left in its natural state as an experimental control. No nutrients or enzymes were introduced to any of the four cells. The systems have since been closely monitored for indications of microbial decomposition of the petroleum product present in the soils. Data collected during the first two months of activity indicate a 78% increase in biodegradation of petroleum in the cells treated with Microbe-Lift, over the untreated cell. MPA will continue this experiment and inform you of the progress achieved using your product.

Sincerely,
MOSTARDI-PLATT ASSOCIATES, INC.

Douglas M. Waring

Douglas M. Waring
Environmental Engineer

DMW/bit

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
T14205

Made in the USA

Compliance Environmental Confirms PCB Transformer Oil Degradation in Bioremediation Test

COMPLIANCE ENVIRONMENTAL, INC.
45. N. Fairfiled Drive, Dover, Delaware, 19901 Phone.fax: 302-697-0681

May 5, 1995

Mr. Barry Richter
Ecological Laboratories, Inc.
P.O. Box 132
Freeport, New York 11520-0132

Re: Transformer Oil Test Project

Dear Mr. Richter:

We would like to thank you for allowing us to include your product, Microbe-Lift, in our bioremediation test project. Microbe-Lift was used along with several other products to investigate the oil degradation process of non PCB transformer oil.

We found that Microbe-Lift could be an effective alternative for transformer oil clean-up projects. Our tests of Microbe-Lift indicated that it possibly contributed to the reduced amount of Total Petroleum Hydrocarbons (TPH) present in our samples.

Thank you for your interest in the project. Please feel free to contact me if you have any questions or concerns.

Sincerely,

COMPLIANCE ENVIRONMENTAL, INC.

Valentino, P. DeRocili, CHMM
Senior Environmental Manager

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
T14206

MICROBE-LIFT® Technology Helps Remediate TPH Contaminated Soils in Georgia and Tennessee

Location: **PCS Nitrogen, Georgia & Tennessee Sites**

Background: PCS Nitrogen, a business unit of Potash Corporation of Saskatchewan, is one of the largest producers of nitrogen worldwide. It produces nitrogen fertilizers and feed ingredients from three manufacturing facilities in the US and one in Trinidad. When they experienced heavy contamination of soils with hydrocarbon and TPH compounds at two of their facilities, they utilized Ecological Laboratories' MICROBE-LIFT® technology to remediate these sites.

Objective: During 2005, 2006, and 2007, **Ecological Laboratories** supplied PCS MICROBE-LIFT®, MICROBE-LIFT® /IND, and MICROBE-LIFT®/SA to be used with nutrient management to enhance and speed the remediation process targeting the removal of the petroleum compounds.

The bioremediation at two sites, in Georgia and Tennessee, included land farming with monthly bioaugmentation application, followed up by wet lay up over colder winter months with the application of microbial treatment.

Results Achieved: These bioremediation programs resulted in site recoveries with dramatic reductions in priority pollutants and TPH. At one site the wet lay up period for three months over the colder period resulted in the reduction of 17 inches of contaminated soil and a corresponding reduction in pollutants, a surprising efficacy considering the low temperature of treatment. It is postulated that the photosynthetic strains in MICROBE-LIFT® provide a substantial advantage in soil remediations.

The following pictures show the dramatic improvement at the Tennessee site:

Fig. 1: *These pictures show the site before the beginning of treatment*

Fig 3: *Excavation to ready the site for land farming shows the extent of contamination.*

Fig. 4: *This picture shows the site after successful remediation.*

The dramatic "after treatment" picture above confirms the efficacy of MICROBE-LIFT®'s photosynthetic consortium in remediating petroleum contaminated soil, and in this case, efficacy in spite of low temperatures.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14207

WASTEWATER TREATMENT - INDUSTRIAL

14300 FOOD PROCESSING

14301 Poultry Slaughterhouse in Karak, Jordan Achieves Compliance with MICROBE-LIFT® Technology

14302 Egg Processor in Belgium Achieves COD Compliance & Reduces Odor with MICROBE-LIFT® Technology

14303 MICROBE-LIFT® Technology Eliminates the Need for Capital Investment at a Rendering Plant in Guatemala

14304 Cheese Factory Optimizes Treatment System and Resolves Odor Problem with MICROBE-LIFT® Technology

14305 Ohio Bakery Reduces FOG in Pretreatment Effluent with MICROBE-LIFT® Technology

14306 New Alternative in the Treatment of Residual Wastewater at Coca Cola Bottling Plant in San Salvador

14307 New England Apple Juice Processor Solves Odor Problems with MICROBE-LIFT® Technology

14308 Grease and Odors are Eliminated and the Treatment System is Restored at a Dairy In Panama

14309 MICROBE-LIFT® Technology Improves Effluent Quality for Brewery in Vietnam

14310 MICROBE-LIFT® Technology Speeds Sugar Cane Waste Composting While Producing Higher Quality Fertilizer

14311 MICROBE-LIFT® Technology Speeds the Breakdown of Plant Litter at a Guatemalan Banana Plantation

The case study results listed above were achieved with MICROBE-LIFT® Technology and products, formulated and manufactured by Ecological Laboratories Inc., with technical support for administering the products provided by Ecological Laboratories Inc., in support of their worldwide representatives.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.

www.EcologicalLabs.com

Made in the USA

Poultry Slaughterhouse in Karak, Jordan Achieves Compliance with MICROBE-LIFT® Technology

Location: **National Poultry Slaughter House, Karak, Jordon**

Background: A 200,000 to 270,000 GPD wastewater treatment plant was experiencing difficulty meeting its effluent discharge limits.
This facility consisted of:
a) Collection tank (60 M^3)
b) Aeration tank (7500M^3)
c) Clarifier tank (1600 M^3)
d) Sludge collection tank (130 M^3)

Wastewater flows from the production area to the collection tank by gravity. It is then pumped up to the aeration tank and thereafter pumped to the clarifier.

Objective: There were three main objectives for the program as follows:

1) Reduce the effluent parameters as to meet permit limits as follows (fig 1):

Parameter	Prior to MICROBE-LIFT®	Permit limit
COD mg/l	4211	150
BOD mg/ml	2725	50
TSS mg/ml	1276	50
FOG mg/ml	612	5
PO4 mg/ml	71	5
NH4 mg/ml	310	5

Fig. 1: *This table indicates plant performance relative to permit limits prior to treatment.*

2) Eliminate the malodors from the sludge tank and the effluent.

3) Remove a 65 cm thick floating layer on the sludge tank.

A dosage plan for a 120-day program was developed using MICROBE-LIFT® technology, produced by **Ecological Laboratories, Inc.** Treatment was implemented on May 16, 2001. The results were monitored and tabulated.

Results Achieved: All waste parameters started to improve immediately after treatment as outlined below (fig. 2 & 3):

Date	COD	BOD	TSS	FOG	PO_4	NH_4
1/17/01	2710	1496	610	173	97	100
2/21/01	3210	1445	702	230	83	214
2/25/01	3891	2023	909	490	80	270
4/25/01	4011	2407	1070	501	80	293
5/16/01	4122	2725	1276	612	71	310
6/16/01	1618	779	760	367	48	187
7/03/01	630	275	311	5.3	3.6	120
9/09/01	293	46	153	1.1	0.3	13
9/16/01	107	12	64	0.3	0.1	2

Fig 2*: The table demonstrates effective reduction of waste parameters.*

Made in the USA

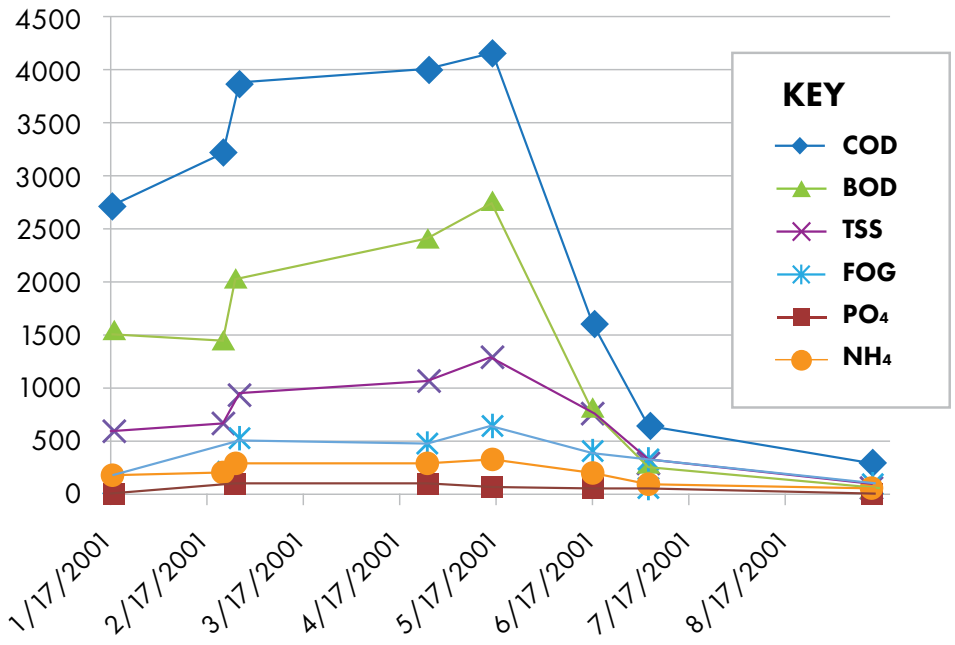


Fig. 3: *Graphic representation of the data shows dramatic improvement in wastewater effluent quality after the application of* MICROBE-LIFT® *on May 16.*

One week after the start of treatment, the bad smell was barely traceable, and as of the 28th of May (12 days after treatment) and throughout the entire duration of the treatment, no malodor was observed.

One month after the start of treatment, the color of the effluent turned to a pink color for two weeks and returned to clear color thereafter. This change of color is evidence of growth of MICROBE-LIFT® formulation's highly active purple bacteria growing in the first four weeks when there was a high concentration of hydrogen sulfide in both the aeration and sludge tank.

The floating layer of the sludge tank virtually disappeared within two months as evidenced in the following table.

Date	16/5	16/6	3/7	9/9 1	6/9
Thickness (cm)	65	32	0.5	00	00

Fig. 4: *Indicates rapid removal of floating sludge on sludge tank.*

Treatment with MICROBE-LIFT® technology was effective in reducing all wastewater parameters to meet the limits set forth. All parameters were reduced by 90-100% compared to prior levels.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14301

Egg Processor in Belgium Achieves COD Compliance & Reduces Odor with MICROBE-LIFT® Technology

Location: **Dion Vandewiele N.V., Zulte, Belgium**

Background:

Dion Vandewiele N.V. has engaged in the production of pasteurized liquid egg products since 1937. Between 3 and 4 million eggs are broken daily, 5 days a week, to produce egg-white, egg-yolk, and some mixed egg products for a total to 900- 1000 tons of end products per week.

The wastewater treatment plant was built 10 years ago and designed for 3 million egg-breaking capacity. At up to 4 million eggs per day, the system is over capacity. The key environmental problems include bad odor (mainly caused by hydrogen sulfide from rotten eggs), sludge build-up, and the inability to meet effluent COD permit levels. Their effluent was not in compliance with government standards.

The system was designed as follows:

1) **Collection tank, which allows for chemical treatment:** This is a 10,000 liter tank with influent flow of 150-170 cbm (million m3/day), ranges in pH from 2-13, and COD concentrations from 5,000-35,000 mg/l. This waste contains 1-2% of egg plus cleaning chemicals (caustic, detergents, and nitric acid) and disinfecting chemicals (peroxide). Sulfuric acid used in the collection tank to neutralize the caustic (>333 liters/day) provides a second source of sulfur. System upsets occur when excess sludge is cycled back into this tank or a high spillage of eggs comes from the pasteurization units, where a blend of egg and water is passed through and wasted until the correct pasteurization temperature is achieved.

2) **Aerated basin:**
A small, aerated basin (which is covered to contain odors) receives 150-170 cbm/day from the collection tank. It has one surface aerator and is maintained at a pH of 7.6 to 8.2.

3) **Large aeration basin:**
The waste from the small aerated basin is discharged to a much larger 3200 cbm aeration basin. With an average retention time of 20 days, this basin has three surface aerators to suck waste from the bottom and spray into the air for aeration. During long-lasting warm periods, the surface may form a crust. If this crust breaks the odor is intolerable.

The egg plant works a five-day week. At the beginning of the week, the waste level in this aerated basin is at 3.5 meters (the minimum level at which the aerators can operate). By the end of the week, the waste depth approaches 5 meters, the maximum depth. 9-10 cbm per hour of wastewater are discharged to the flotation unit.

4) **The flotation unit:**
This unit sends 5-7 cbm per hour of water to the pond and 3-4 cbm per hour to sludge storage. Flocculation is accomplished by "polyelectrolytes" which keep the sludge (approximately 1/3 of volume) on the surface.

5a) Sludge storage tank:

This tank has a capacity of 700 cbm with aeration carpets installed on the bottom of the tank for further digestion. Solids content of this sludge is about 3%.

5b) Pond:

The water phase of the effluent from the aeration basin is discharged to the pond. This pond of 225 cbm contains a smaller 75 cbm Reed Pond and a checkpoint for controlling release based on COD. The COD should not exceed 125 mg/l.

The sludge tank is the area with the most critical problems. As long as the sludge does not exceed half of the capacity of the tank, the existing carpet aerators are sufficient to feed the existing microbial population. However, when the sludge volume increases over half the capacity the tank goes septic with a sulfide odor that permeates the whole neighborhood. It is much more difficult to dispose of septic sludge often requiring decanting and incineration at a much higher cost.

Dion Vandewiele N.V. turned to Ecological Laboratories Inc, for their MICROBE-LIFT® wastewater technology. After fully evaluating the system, Ecological Laboratories' technical staff developed a treatment plan designed to achieve the following:

- Remove a major source of hydrogen sulfide ($H2^S$)
- Convert sulfide into elemental sulfur and then to sulfate (no odor)
- Improve biodegradation with a lower yield reducing the formation of sludge by 30-60%
- Clear pond of surface solids and consistently reduce the COD below 125 mg/l in the final effluent.

The treatment plan calls for the dosage schedule of MICROBE-LIFT® wastewater technology listed in the following chart:

Day	Small Aeration	Basin Aeration Basin	Sludge Storage Tank	Pond
		INOCULATION SCHEDULE		
1	5,0 gal	12 gal	6 gal	2.0 gal
		FIRST MONTH SCHEDULE		
7	2.5 gal	6 gal	4 gal	1.5 gal
14	2.5 gal	6 gal	4 gal	1.5 gal
21	2.5 gal	6 gal	4 gal	1.5 gal
28	2.5 gal	6 gal	4 gal	1.5 gal
		MAINTENANCE DOSAGE		
weekly	1.0 gal	2 gal	1 gal	1.0 gal

Note: If there is an extra toxic load of egg products, due to an incident in production, the system is already equipped to handle this and will prevent destabilization. However, it is recommended to use an additional dosage of MICROBE-LIFT® in response to such upsets to ensure stabilization.

In addition to MICROBE-LIFT® an additional product, MICROBE-LIFT®/OX is added to the sludge storage tank at least for the first two months of treatment to help provide enough oxygen to optimize the

action of the MICROBE-LIFT® technology. MICROBE-LIFT®/OX should also be added in conjunction with MICROBE-LIFT® if sludge storage exceeds its 50% capacity, since the air beds only produce enough oxygen to support 50% capacity of the basin. To apply OX, it should be slurried in a ratio of 1 kg OX to 3-4 liters of water prior to addltion.

Recommended dosage of OX to the storage tank along with MICROBE-LIFT®:

Day 1 – 175 kg
Day 2 – 175 kg
Day 28 – 175 kg
Maintenance – 50 kg bi -weekly

Results Achieved: The treatment plan was implemented in middle of May 2001. At this time the neighborhood was complaining about very bad odor and the plant owner was being threatened with plant closure.

Odor	COD influent mg/l	COD effluent mg/l	Visual Apperance of Effluent
Day 1: Very bad odor at small aeration basin & sludge storage polluted the entire neighborhood. (Most of the floating particles were skimmed off)	21,600	245	Cloudy water and a lot of coagulated particles in pond and in reed pond, hindering the growth of the reed.
Day 15: Bad odor was significantly reduced and limited to the small aeration basin and sludge storage tank	16,240	93	The water was becoming clearer.
Day 30: No odor observed in the small basin and only a small occasional odor-wave at the sludge storage tank.	15,400	70	Clear water in the pond down to the bottom (one meter deep)
Day 45: No odors detectible	16,500	70	Clear water

By day 15 the effluent was becoming clearer, the odor was reduced, and the effluent met the required COD parameter. By day 30, clear water was evident down to the bottom of the pond indicated the solids were being reduced.

The goals of the program were met:

1. No detectable odors remained
2. The effluent was clear water with reduced turbidity and solids
3. Effluent COD met specified permit limit

This plant will continue to observe trends particularly based on production and maintenance issues and will respond with increased dosages of MICROBE-LIFT® as necessary to maintain treatment excellence. With the resolution of odor problems and COD compliance the plant was no longer concerned about potential shut down.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14302

MICROBE-LIFT® Technology Eliminates the Need for Capital Investment at a Rendering Plant in Guatamala

Location: **ARECA's Frisa Rendering Plant, Palin, Guatemala**

Background:

The facility is a rendering plant, utilizing a limited waste water system. The basic design has a cooling tower, from which the water passes through a grease trap and then into an aeration tower. The water is then discharged into a series of three small lagoons, with a retention time that is calculated to be between 10 and 15 days based on a system volume of 110,000 gallons in the tanks and lagoons and the flow which was believed to vary between 6,857and 11,428 gallons per day.

Objective:

This plant contacted the technical representative at **Ecological Laboratories Inc.** to determine if bioaugmentation could lower the effluent COD to avoid the need to expand their system. The local regulations had targeted a 50% reduction by 2014 and an additional 50% reduction by 2024 for every facility in the river basin.

After thorough evaluation of their system, **Ecological Laboratories Inc.** developed a treatment plan using MICROBE-LIFT®/IND as follows:

Location	Volume Gallons	Week #1 Gal/week	Weeks #2-4 Gal/week	Maintenance Gal/week
Aerator #1	10 m^3	2	1	½
Lagoon #1	120 m^3	2	1	½
Lagoon #2	120 m^3	1	½	½
Lagoon #3	120 m^3	1	½	½
Total	370 m^3	6	3	2

Results Achieved:

From the initial application of MICROBE-LIFT®/IND, the effluent COD was reduced by 74% while the effluent BOD was reduced by 86%. (See chart below)

Parameter	Influent	Effluent (April 1)	Effluent (June 6)
COD mg/l	6,290	1,420	363
BOD mg/l	5,700	1,140	164
Improvement		74%	86%

Based on the first 5 weeks of the plan, treatment with MICROBE-LIFT®/IND was able to meet the 2024 goals without any further capital investment, while eliminating odor and significantly reducing flies.

Fig. 1: *These pictures taken on 5/22/09 (above) and 7/1/09 (below) show the condition of the three lagoons after treatment compared to during treatment. Note the condition of the lagoons improve from the first to the third lagoon in the series.*

Ecological Laboratories, Inc. also recommended that by constructing a simple block wall one meter high to increase the lagoon depths, they could increase the retention time to provide an anticipated effluent discharge below 100 mg/l COD and 50 mg/l BOD.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14303

Cheese Factory Optimizes Treatment System and Resolves Odor Problem with MICROBE-LIFT® Technology

Location: **Cheese Factory, Ohio**

Background: A small cheese factory with an activated sludge system was experiencing high levels of sulfide and mercaptan odors, high solids that clogged sand filters, and poor settling in their clarifier. All these problems were signs of inadequate treatment efficiency. Their 10,000-gallon daily flow was discharged to a 140,000-gallon aerobic digester, which then decanted to a clarifier where significant polymer addition was required to achieve settling.

Objective: This factory had experienced numerous odor complaints and their clogged sand filters required ever-increasing maintenance. They were having difficulty meeting discharge limits and were well aware that their system was not providing effective or cost-efficient treatment. MICROBE-LIFT®/IND was the prescribed treatment.

Results Achieved: Based on the recommendation of Ecological Laboratories' technical staff, a shock dose of MICROBE-LIFT®/IND was added to all tanks in the system. As a result, sulfide and mercaptan odors were reduced by an estimated 95-100% in 24 hours. The air system was then changed to provide more dissolved oxygen to the aeration tanks. MICROBE-LIFT®/IND in the aeration tanks resulted in clearer water and improved settling in the clarifier. Use of polymer in clarifier to achieve settling was completely suspended resulting in substantial cost savings to the factory.

This plant maintains treatment efficacy using a low maintenance dose of MICROBE-LIFT®/IND which effectively maintains reduced odors, low TSS, and efficient settling in the clarifier. The cost of treatment is more than covered by the elimination of the use of expensive polymers. Combined with reduced maintenance on the sand filters, this treatment provides a handsome return on investment.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.
www.EcologicalLabs.com

CS14304

Made in the USA

Ohio Bakery Reduces FOG in Pretreatment Effluent with MICROBE-LIFT® Technology

Location: **Bakery , Ohio**

Background:

A major full service bakery in Northern Ohio has a pretreatment plant which discharges to the local village wastewater treatment plant. The average daily flow through this plant is 15,000 to 25,000 per day. Influent waste concentration ranges from 6,000 to 100,000 mg/l CBOD; average suspended solids is 6,000 mg/l; and FOG level ranges between 800 mg/l to 1,000 mg/l.

Objective:

The waste is treated aerobically in an activated sludge system consisting of two 50,000 gallon aerated tanks in series. The wastewater from the secondary tank is pumped onto a gravity belt with polymers being injected into the waste stream.

The municipality was requiring further reduction of effluent FOG since this causes sewer blockages requiring high maintenance costs.

The bakery needed a mechanism to improve the activity of their system to reduce FOG and organics. MICROBE-LIFT® was selected to enhance biological activity to improve degradation. MICROBE-LIFT® was added to the system with an initial charge of two gallons, followed by one quart per day added for a ten-day period. The maintenance dose was then reduced to one pint per day.

Results Achieved:

As a result of this treatment the second aeration tank took on a richer brown color and there was less grease as evidenced by the absence of the grease that used to collect on the paddles of the sludge thickener belt. The plant was able to reduce the usage of sludge-thickening polymer by 70%.

After treatment, the average effluent disharge to the local village POTW was reduced to an average CBOD of <200 mg/l, TSS of 200-400 mg/l, and an average FOG of 15 mg/l or less. Both the bakery and the municipality considered this treatment a dramatic success.

The novel consortium of bacteria in MICROBE-LIFT®/IND enhances microbial action to speed degradation of a wide range of waste organics including the residual hard-to-degrade long chain fatty acids typically measured as FOG. Typically the effects of treating FOG containing waste with MICROBE-LIFT® are quite dramatic.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14305

Made in the USA

New Alternative in the Treatment of Residual Wastewater at Coca Cola Bottling Plant in San Salvador

Location:

The Eco Plant of Nixapa Coca Cola, San Salvador

Background:

This Coca Cola bottling plant added a new bottling line that doubled its production that, in turn, doubled the organic loading to its activated sludge waste treatment plant.

This plant needed a quick solution to address increased treatment demand. They proceeded to make several source control changes in the facility to reduce organic loading but these changes were not sufficient to handle the demand and the average effluent COD remained over 2000 mg/l as opposed to a regulation guide of 450 mg/l.

Bioaugmentation with MICROBE-LIFT® technology was a logical solution. **Ecological Laboratories Inc.** is the developer and manufacturer of MICROBE-LIFT® technology.

Pryeasa SA de CV is the exclusive distributor of MICROBE-LIFT® in San Salvador. They provided the technical recommendation for addition of MICROBE-LIFT® to increase the biological degradation capacity of Coca Cola's waste treatment system.

Results:

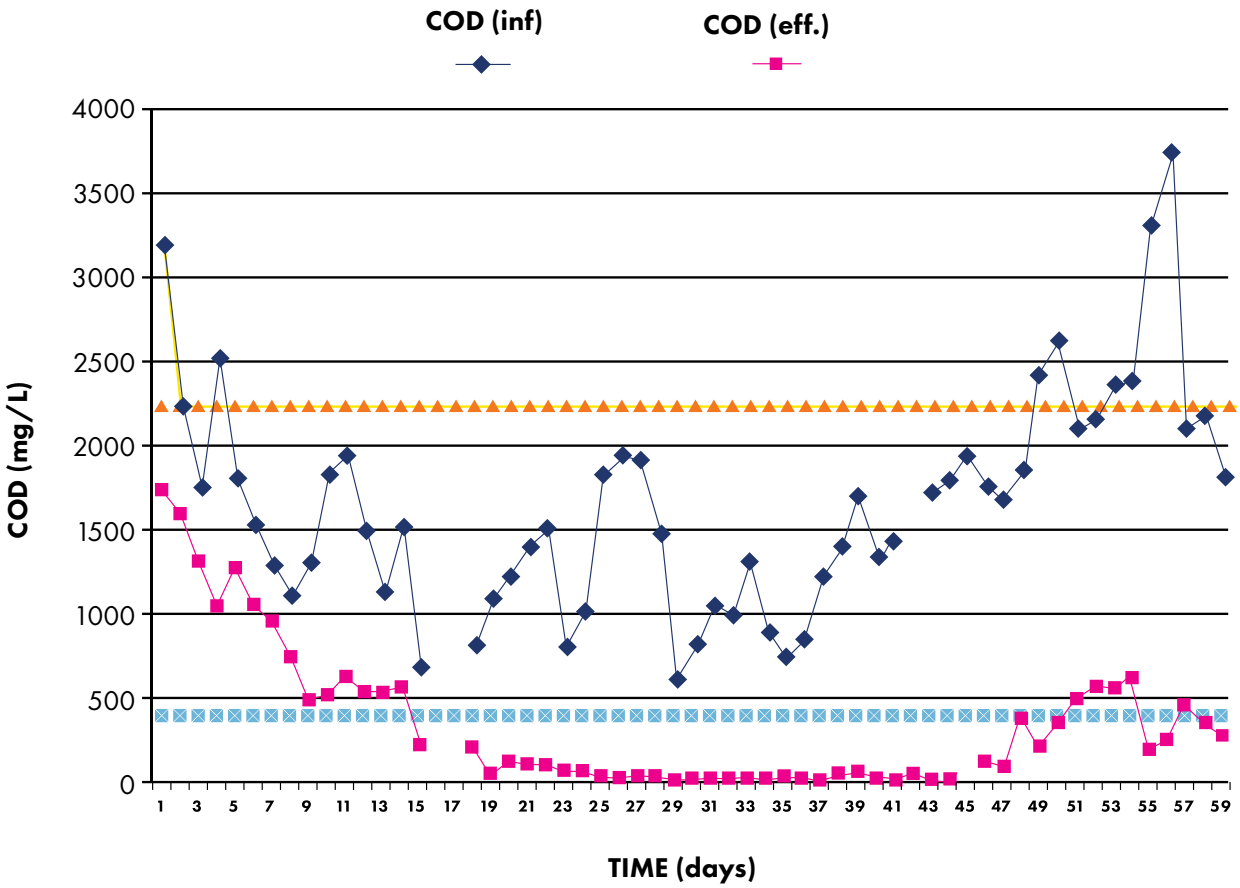
Results were immediate. Dosage of MICROBE-LIFT® was introduced as recommended and within two weeks, the plant was operating within the regulation requirement. After three weeks the effluent was below 50 mg/l COD on a regular basis. Even when there was a spike in influent COD, MICROBE-LIFT® was able to bring the effluent back into compliance very quickly.

Ing. Danilo Juárez, Head of plant maintenance proclaims ,

"We have increased the efficiency of our activated sludge system to more than 90% with the use of MICROBE-LIFT®, in conjunction with a reduction of organic loading to the system as well as the application of a heavy weight flocculant. The efficiency levels now being attained have never before been achieved with the use of other bacterial products in our treatment process."

FIG. 1: *The Eco Plant of Nixapa Coca Cola has experienced much success with the utilization of the MICROBE-LIFT® bacteria. In the photograph is the gentleman in the white shirt, Ing. Danilo Juárez, Head of plant maintenance, and Ing. Roberto Calderón Avelar,, Director of PRYEASA de C.V., the exclusive representatives for MICROBE-LIFT® technology in El Salvador.*

New Alternative in the Treatment of Residual Wastewater at Coca Cola Bottling Plant in San Salvador



The Fig.1: *The chart above shows the COD level of the effluent versus the COD of the influent waste stream. The effluent COD is well below the required 450 mg/l (blue line) with the exception of an influent spike that is quickly recovered.*

Conclusion:

The plant management was very pleased with the performance of *MICROBE-LIFT® technology* in resolving their requirements and a testimonial of their satisfaction is on file.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.

www.EcologicalLabs.com

CS14306

New England Apple Juice Processor Solves Odor Problems with MICROBE-LIFT® Technology

Location: **Apple Juice Processor, New England**

Background: A very large New England apple juice processor, located in a heavily populated area, was facing fines and possible shutdown if the factory was not able to reduce odors from its wastewater pre-treatment facility.

Objective: After investigating the potential of bioaugmentation technology to increase the efficacy of wastewater treatment, the processor turned to **Ecological Laboratories**' MICROBE-LIFT® technology to attempt to resolve their problem.

A shock treatment of 100 ppm MICROBE-LIFT® formulation was dosed to the 700,000 gallon aeration tanks on day one. The impact on odor was dramatic showing odor reduction within three hours. Thereafter, a declining dosage schedule was prescribed as follows:

Time	Dosage
Day 1	100 ppm
Day 2	50 ppm
Day 3	5 ppm
Day 4 & thereafter	5 ppm

Results Achieved: This plant avoided fines and possible shutdown after MICROBE-LIFT® resolved their odor problem in less than a week of treatment. The plant continues to use a maintenance dose to avoid future recurrence of odor problems.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14307

Made in the USA

Grease and Odors are Eliminated and the Treatment System is Restored at a Dairy In Panama

Location: **Refrescos Nacionales S.A. , Panama City, Panama**

Background: The grease traps and lagoon treatment system at this dairy beverage plant was severely overloaded with the high-organic dairy waste. Grease and other solids covered the surface of the lagoon and odors were intolerable, saturating clothing, and eliciting numerous complaints from surrounding neighborhoods. Biological treatment was poor as confirmed by microscopic exam that showed a high population of worms and solids that would not be present in an active biomass.

Fig. 1: *Shows the lagoon covered with surface scum.*

Objective: The facility wanted to eliminate the grease and surface scum that interfere with flow and aeration and improve waste treatment. They also wanted to eliminate the malodors that plagued workers and neighbors alike.

When contacted, Ecological Labs designed a treatment based on MICROBE-LIFT®/IND. This technology contains a highly active consortium of bacteria that rapidly eliminates grease and solids and restores energetic microbial action to lagoons. The program called for an initial dose of 4 gallons with two-gallon monthly maintenance doses.

Results Achieved: Within three weeks of the initial application, the oils and grease completely dissolved and the water changed color. Turtles that had not been present for years began to reappear.

Grease and Odors are Eliminated and the Treatment System is Restored at a Dairy In Panama

Fig. 2: *At three weeks, the surface scum was eliminated.*

The MICROBE-LIFT® technical representative recommended modification of the system by reattachment of some unused grease traps that had previously been disconnected and to dig one additional trap.

After twelve weeks, the system was free of solids and odors. The traps were odor-free and the lagoon had no detectable presence of solids.

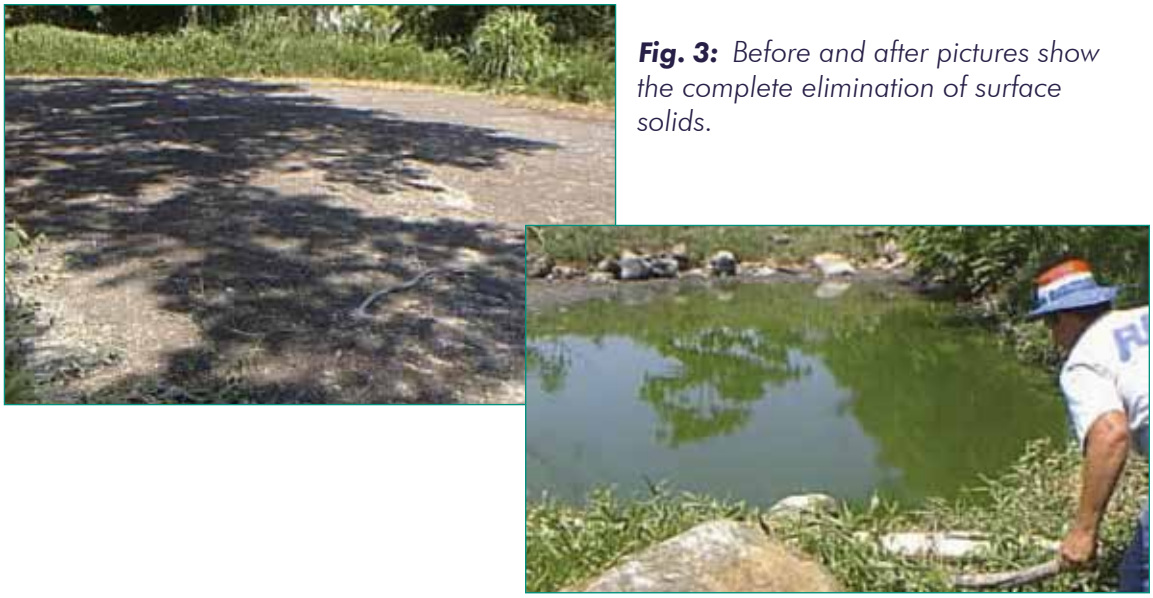


Fig. 3: *Before and after pictures show the complete elimination of surface solids.*

After treatment, no further odor complaints were received. The condition of the lagoon continued to improve. The undesirable insects such as flies and gnats, that had plagued the area prior to treatment, disappeared and turtles and other wildlife returned.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.

www.EcologicalLabs.com

CS14308

MICROBE-LIFT® Technology Improves Effluent Quality for Brewery in Vietnam

Location: **Hatay Brewery, Vietnam**

Background:

Hatay Brewery is the producer of world-class beers such as Heineken, Tiger, Anchor and Bivina. It also distributes other beers and beverages such as Larue Export, Fosters, Amber and Orangina.

This brewery is one of the most modern, state of the art, automated breweries in south East Asia with an investment of 65 million USD in their facilities. Its equipment is of world class standard. The brew house, filtration and packaging operations use the latest industrial technology with a capacity of 56 million liters. Hatay Brewery also has sales offices and warehouses in Hanoi, Hai Phong, Vinh.

Hatay Brewery Ltd has long been known for not only its internationally acclaimed high quality beer brands but also for its contribution towards the development of Hatay province in particular and the community in general.

Objective:

With a concern for high environmental standards, this brewery contacted **Ecological Laboratories, Inc.** for MICROBE-LIFT® technology for wastewater treatment, for potential assistance in meeting effluent quality limits.

Fig. 1: *Initial evaluation of the wastewater shows water that is dark in color with sludge and some black solids floating on the surface.*

Fig. 2: *Solids are evident around the edges of the pond.*

The pictures above show the condition of the 150 M^3 monitoring pond at the brewery site on 2 February 04, prior to treatment. A very strong odor was evident.

Results Achieved:

The picture below shows the condition of the pond eight days later, on 10 February 04, after a daily dose of one gallon has been applied. The water had become much clearer, the odor had been greatly reduced, and the COD and TSS had been reduced significantly.

Fig. 3: *After only eight days of treatment, the water s much cleaner. Note the absence of the scum around the edge of the lagoon.*

The laboratory results confirm that the effluent is much cleaner with improvement of nearly 48% in COD degradation and 91% in TSS removal compared to results experienced prior to treatment. This is a very dramatic improvement.

Test Result:

No.	Date	Parameters		
		pH x	COD total Mg/L	TSS Mg/L
1	02/02/2004	7.81	164	74
2	02/04/2004	7.96	122	47
3	02/10/2004	7.97	86	7

Interestingly, this extremely positive result was obtained with a totally natural biological treatment without any additional chemicals added.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14309

MICROBE-LIFT® Technology Speeds Sugar Cane Waste Composting while Producing Higher Quality Fertilizer

Location: **Magdalena Sugar Plantation , Guatemala**

Background: On sugar plantations, cane waste solids called "cachaza" are produced as a by-product. This cachaza is separated from the sugar cane juice and composted for use as a fertilizer.

Magdalena Plantation produces 900 cubic meters of cachaza daily. Using a conveyor system they build 400 meter long windrow rows of cachaza each day and have space for 40 of these rows on site.

Fig. 1: *A large conveyor system was built to handle large volumes of cachaza filling dump trucks which will be used to build windrows.*

Fig. 2: *This picture depicts placement of the windrows.*

Based on numerous field applications, Ecological's core technology has shown benefits in increasing the efficacy of composting. Use of MICROBE-LIFT® core technology has been shown to:

- Shorten the time required to reach heap temperature
- Reduce time to stabilize the compost
- Reduce residual volume
- Improve screening properties
- Improve fertilizer value of the compost

Objective:

The plantation's management wanted to increase efficiency of composting in order to reduce labor and increase the capacity of their facility. A field trial was developed to assess the benefits of bioaugmentation with MICROBE-LIFT® core technology that had shown efficacy in numerous other compost applications.

Fig. 3 & 4: *The standard procedure of adding moisture to the cachaza before composting offered an ideal opportunity for seeding the cachaza with* MICROBE-LIFT®

Two identical sections of a row were set up whereby one was inoculated with MICROBE-LIFT® while the other represented an uninoculated control. The same volume of moisture was added to the cachaza in each row. Temperature and humidity of both rows were measured every week.

Fig. 5-7: *Temperature is recorded and samples taken for moisture analysis.*

Typically a tractor aerates the rows on a scheduled basis. This process was maintained on the regular schedule for both treated and control rows.

After the initial application at the factory, additional applications are made in the field. The first of the field application was performed after 10 days.

Fig. 8 & 9: *Each dose is sprayed on the row before the aerating tractor turns the row to mix, allow gases to escape, and oxygenate the cultures.*

Results Achieved:

The increased degradation of the treated windrow compared to the control is already very evident when the third application was performed 23 days later.

Fig. 10: *The difference in the rate of composting is very evident in the treated vs. the control rows by this time validating the increased degradation rate of* MICROBE-LIFT® *cultures.*

Faster composting reduced labor costs by reducing processing time. Since the cachaza that contained MICROBE-LIFT® was also being composted at a faster rate, it offered less resistance to the aerating tractor saving additional time and labor. This in turn resulted in less wear of tractor parts and less use of diesel fuel by the tractor. In addition, they noted a significant reduction in the flies in the area.

Since the microorganisms in MICROBE-LIFT® are growing in the cachaza, the residual microbes in the compost will have additional value in the fertilizer as these strains have demonstrated the capability to increase growth and yields in agriculture crop applications. Overall this trial was determined to be a success providing numerous benefits to the management of the sugar plantation.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.

www.EcologicalLabs.com

CS14310

MICROBE-LIFT® Technology Speeds the Breakdown of Plant Litter at a Guatemalan Banana Plantation

Location: **Banana Plantation, Guatemala**

Background: Typical of most banana plantations, this operation left plant litter such as leaves and stalks on the floor of the banana stand in order to decompose and return nutrients to the soil to support new growth. However, it takes significant time for this litter to decompose or "compost" slowing the availability of needed nutrients.

Objective: Additional processing of the litter such as mechanical grinding to speed its breakdown was simply not cost effective, however, management considered the slow recovery of nutrients to be a limiting factor in the efficient growth of new crops.

While this was not a typical compost process, a program was developed to assess the ability of MICROBE-LIFT® core technology, to speed the breakdown of this litter. Based on the experimental design, MICROBE-LIFT® was applied at recommended dosage through the central irrigation system.

Fig. 1 &2: *After product was added to the irrigation water tank, it was sprayed through the plantation's irrigation system.*

Results Achieved: Within two months after treatment significantly improved composting of the ground litter had been achieved.

Fig. 3 & 4: *These pictures show dramatic improvement in the breakdown of the plant litter in only two months time.*

This trial was considered a success with more rapid breakdown of litter providing a means of increasing nutrient availability for faster growth of new crops.

In addition to providing faster restoration of nutrients, the microbes in **Ecological Lab's** core technology are known to increase plant growth, productivity, and disease resistance in agricultural crops. The growth of these microbes in the plant litter provides an added value fertilizer for the growth of new crops.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14311

WASTEWATER TREATMENT - INDUSTRIAL

14400 TEXTILE

14401 MICROBE-LIFT® Technology Helps Blue Jean Stone Washer Improve Effluent Quality

The case study results listed above were achieved with MICROBE-LIFT® Technology and products, formulated and manufactured by Ecological Laboratories Inc., with technical support for administering the products provided by Ecological Laboratories Inc., in support of their worldwide representatives.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com

Made in the USA

MICROBE-LIFT® Technology Helps Blue Jean Stone Washer Improve Effluent Quality

Location: Textile Company, Caribbean

Background: Ecological Laboratories Inc. had utilized MICROBE-LIFT® technology in several textile fabrication facilities in the Caribbean and South America with excellent success.

Objective: The major waste treatment challenges of textile manufacturers include degrading sizing chemicals and color elements. The operations in the Caribbean and South America generally use a series of lagoons to treat their waste.

In this particular system of lagoons, MICROBE-LIFT® was added to the first facultative lagoon along with the caustic soda and micronutrients that were normally added. The objective was to eliminate the strong indigo color as evidenced in the following pictures.

Fig. 1: *These pictures of the lagoons show extreme color in the water and surface scum.*

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Fig. 2: *The effluent from the plant shows extreme level of indigo pigment in the wastewater.*

The dosage of MICROBE-LIFT® varied with changes in load and flow and MICROBE-LIFT® was added to the other lagoons in sequence at a decreasing rate. This system is very cost-effective as it does not require electrical aeration or pumps, and does not require advanced technical support of the operations. The wastewater is very colored with indigo dye that is being removed from the fabric during stone washing.

Results Achieved:

After treatment, the water is dramatically cleaner in color and the BOD has been reduced to 5 mg/l.

Fig. 3: *This picture shows a much cleaner lagoon after* MICROBE-LIFT® *treatment.*

Fig. 3: *The final effluent is dramatically cleaner showing clarity similar to that which you would expect to see in drinking water.*

The customer was very pleased that this extremely positive result was obtained with totally natural biological treatment that optimized the biological degradation of the waste. No polymers or other chemical treatments were required.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14401

WASTEWATER TREATMENT - INDUSTRIAL

14500 PALM OIL

14501 Palm Oil Mill Remediates Wastewater Treatment System with MICROBE-LIFT® Technology in Indonesia

14502 Palm Oil Mill Achieves Wastewater Effluent Goals in Sabah, Malaysia with MICROBE-LIFT® Technology

The case study results listed above were achieved with MICROBE-LIFT® Technology and products, formulated and manufactured by Ecological Laboratories Inc., with technical support for administering the products provided by Ecological Laboratories Inc., in support of their worldwide representatives.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.

www.EcologicalLabs.com

CS14500

Palm Oil Mill Remediates Wastewater Treatment System with MICROBE-LIFT® Technology in Indonesia

Location: **PHG Nubika Jaya, Labuhan Batu, Indonesia**

Background: PHG Nubika Jaya is located in the regency of Labuhan Batu in the North Sumatra region. The manufacturing complex consists of 3 separate manufacturing entities including a palm oil mill that produces crude palm oil, a refinery plant, and an oleo-chemical facility. All the wastewater from these manufacturing facilities share the same effluent pond and, because of this, the quality standard of a POME has to meet the refinery and olechem standard. Hence this makes the project very unique and very challenging.

	Palm Oil Mill Max value (mg/l)	Refinery Max value (mg/l)	Olechemical Max value (mg/l)
BOD	100	75	
COD	350	250	160
TSS	250	60	100
FOG	25	5	10
Total Nirogen /Ammonia	50	na	10
Phosphate (PO_4)	na	2	5
pH	6 to 9	6 to 9	6 to 9
Max waste debit	2,5 m^3/ton cpo	0,5m^3/ton	4m^3/ton

Table 1: *Quality Standard set by the government.*

The daily flow rate of the effluent from the three plants is estimated at 80 m3/hr, and the plant operates at least 20 hours daily. The wastewater treatment system comprises a large pond system, with a few aerators in 2 of the ponds. The total holding volume of the eight-pond system is about 200,000m3. Therefore, the total hydraulic retention time is more than 100 days. The final effluent parameters are shown (table 2 on next page) and the effluent were of red terra cotta color and had a faint smell of ammonia.

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Parameter	Average Parameter Jan - July 2010 mg/L	Government Quality Standard of POME Max. mg/L	Target 1 20 % drop on overall parameter mg/L	Target 1 40 % drop on overall parameter mg/L
BOD	151	100	120	90
COD	275	350	220	165
TSS	196	250	156	90
Ammonia	27	50	21	16
POG	9.9	5	8	6

Table 2: *This table provides effluent treatment parameters accomplished to date and specifies the target for improved treatment.*

Objective:

Ecological Laboratories, Inc. was asked to propose a program aimed at meeting the limits specified in table one.

Ecological Laboratories, Inc. proposed a treatment program whereby the ponds would be improved one at a time in sequence from the last pond back to the first pond. Treatment will solubilize collected oil and settled sludge causing an initial increase in organic loading. By treating one lagoon at a time, they will avoid dramatically over-loading the system which would result in deterioration of effluent quality.

Ecological Laboratories, Inc. recommended bioaugmentation based on MICROBE-LIFT®/IND. **Ecological Laboratories, Inc.** recommended inoculation of pond #8 only to kick-start the bioremediation process. In addition, they proposed the construction of a plug flow bioreactor equipped with biomedia and aeration to help achieve the rate of degradation required with the limited 5-8 hours of retention time provided. The new installation is considered pond #9. The following table indicates the targets for the initial application of MICROBE-LIFT®/IND :

Parameter	Average Parameter Jan - July 2010 mg/L	Government Quality Standard of POME Max. mg/L	Target 1 20 % drop on overall parameter mg/L	Target 1 40 % drop on overall parameter mg/L
BOD	151	100	120	90
COD	275	350	220	165
TSS	196	250	156	90
Ammonia	27	50	21	16
POG	9.9	5	8	6

Table 3*: The initial goal was to drop effluent parameters by 20%.*

Results Achieved: The inoculation of MICROBE-LIFT®/IND was performed on Feb 10th, 2010 by the staff of Nubika Jaya supervised by Ecological Laboratoires, Inc and Planet Biru Indonesia. Product was dosed into both pond #8 and pond #9.

A total of two months supply was applied at the following dosage rates:

Day	Date	Dosing (gallons)
Day 1	02/10/2011 Thursday	150
Week 1	02/17/2011 Thursday	64
Week 2	02/24/2011 Thursday	64
Week 2	03/03/2011 Thursday	64
Week 4	03/10/2011 Thursday	64
Week 5	03/17/2011 Thursday	18
Week 6	03/24/2011 Thursday	18
Week 7	03/31/2011 Thursday	18
Week 8	04/07/2011 Thursday	18

Table 4: *Dosage schedule for* MICROBE-LIFT®/IND *in pond #8.*

Week	Day	Date	Inlet Sector	Biomedia Sector	Diffuse Sector	Total
Week 1	1	02/15/2011 Wednesday	1	4	1	6
	3	02/18/2011 Saturday	4	2	0	6
Week 2	6	02/22/2011 Tuesday	2	0	0	2
	10	02/26/2011 Saturday	1	1	0	2
Week 3	13	03/01/2011 Tuesday	2	0	0	2
	17	03/05/2011 Saturday	1	1	0	2
Week 3	20	03/08/2011 Tuesday	2	0	0	2
	24	03/12/2011 Saturday	1	1	0	2
Week 5	27	03/15/2011 Tuesday	2	0	0	2
	31	03/19/2011 Saturday	1	1	0	2
Week 6	34	03/22/2011 Tuesday	2	0	0	2
	38	03/26/2011 Saturday	1	1	0	2
Week 7	41	03/29/2011 Tuesday	2	0	0	2
	45	04/02/2011 Saturday	1	1	0	2
Week 8	48	04/05/2011 Tuesday	1	0	0	1
					Total	37

Table 5: *Dosage schedule for* MICROBE-LIFT®/IND *to pond #9. Note this is a higher rate of inoculation because of shorter retention time.*

Fig. 1: *Inoculation of* MICROBE-LIFT®/IND *by the Nubika Jaya team was made from a boat to assure adequate distribution.*

Two weeks after the first application of MICROBE-LIFT®/IND in pond #8, there was bubbling in the pond indicating a tremendous amount of anaerobic activity as the new microbes become established in the pond.

Fig. 2: *Shows bubbling starting 10 days after inoculation in February in pond #8.*

Fig. 3: *Depicts dramatic bubbling in March, evidence of substantially increased biological activity.*

Apart from the bubbling activity noted at pond #8, the water quality had improved in pond #9. When the water sample was collected on March 27th there was hardly any odor from the final effluent, a substantial change from before treatment. The color of the effluent had also improved turning into a brown tea color after only one month after initial dosing.

Fig. 4: *Color of effluent before treatment was a medium, turbid brown.*

Fig. 5: *After treatment water was a clear, tan color.*

In addition to the improvement in appearance and smell, the water parameters had improved to reach and exceed the level 1 targets specfiied. The table below shows an average 30% drop in all parameters in March compared to the average prior data collected in 2010.

	Average Prior	Target #1	March Result
TSS mg/l	196	156.8	145
Ammonia mg/l	27.11714	21.69371	15.4
BOD mg/l	151.2	120.96	112.4
COD mg/l	275.7629	220.6103	203.77
Nitrogen mg/l	34.545	27.636	19.36
FOG mg/l	9.9	7.92	7.5

Fig. 6: *All parameters were reduced dramatically ranging from 26% to 43%.*

The following graph showcases the actual result. The treatment performed better than expected in the first month:

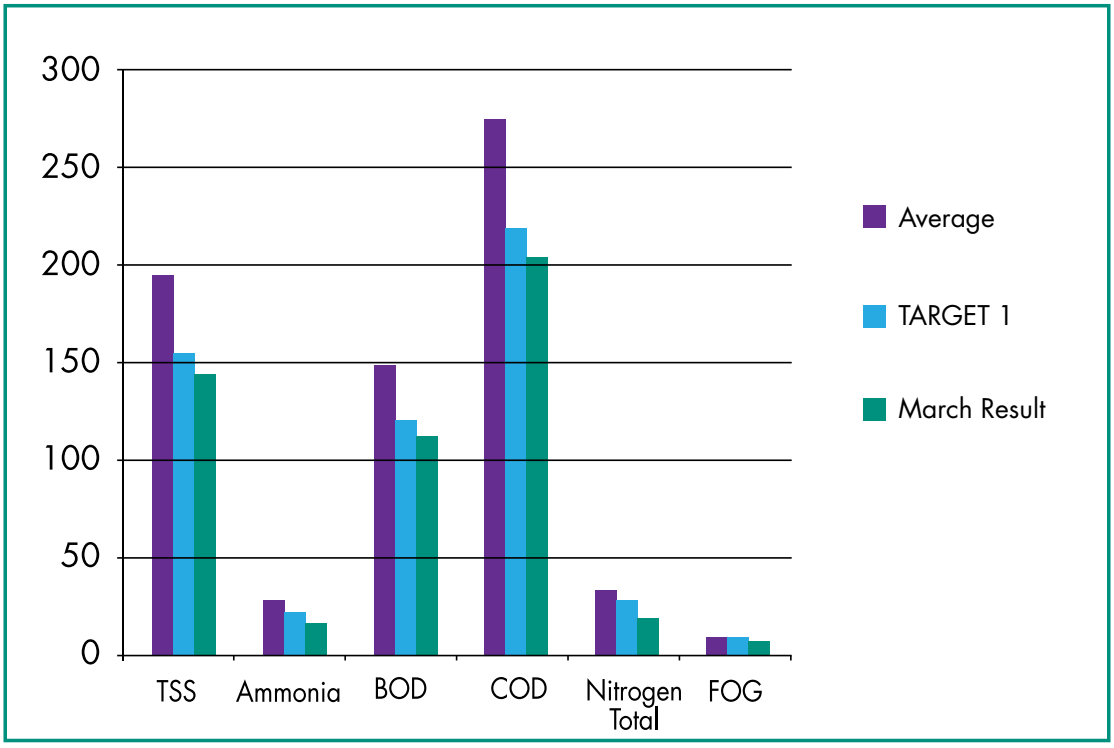

Fig.7: *Performance of* MICROBE-LIFT® *on the final effluent parameters shows consistent, significant improvement in treatment.*

Conclusion and recommmendation: The inoculation of MICROBE-LIFT®/IND has been proven successful at both pond #8 and pond #9. The action was dramatically evident with the bubbling of pond #8 which showed the digestion of bottom sludge and waste organics. There was also a change in color and the removal of odor in the final pond.

The overall water quality improved on an average >30% compared to first trimester 2010 averages. It is believed that the system will further improve the effluent quality once it reaches optimum level in another 1-2 months.

We recommended continuing the maintenance dosage of 15 gallons MICROBE-LIFT® weekly at pond #8 for another month to optimize activity in this pond before commencing stage 2 to restore pond #7. Continue to dose and aerate pond #9 at one gallon, twice a week to maintain bioreactor functionality. This is important in order to maintain efficacy of treatment once restoration of pond #7 commences.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14501

Palm Oil Mill Achieves Wastewater Effluent Goals in Sabah, Malaysia

with MICROBE-LIFT® Technology

Location: **Palm Oil Mill, Sabah, Malaysia**

Background: This palm oil mill was having difficulty meeting effluent requirements due to build-up of sludge in its treatment lagoons. This mill was under pressure from the government to meet effluent requirements and from the surrounding area residents to eliminate tremendous malodor emanating from the lagoon system. This company was aware of the substantial cost of dredging the lagoon and was looking for a more cost-effective solution.

Fig. 1: This picture shows the final effluent lagoon completely impacted with sludge actually forming islands visible from the surface (7 July, 2007).

Objective: **Ecological Laboratories, Inc.** was contacted and asked if bioremediation could offer a solution to eliminate the sludge and restore the treatment capacity of the lagoon.

Ecological Laboratories, Inc. responded to the challenge and developed a highly ambitious treatment program based on the MICROBE-LIFT® microbial technology supported by an oxygenating chemical BioAktiv. The object was to remediate the final effluent pond first and then treat preceding ponds one a time until the entire system was treated. By treating one lagoon at a time, they could avoid a massive treatment overload that would be caused by solubilizing too much sludge organics at one time. By treating lagoons one at a time, they would be able to maintain higher quality effluent while removing the collected sludge. As sludge is removed, the ponds effectively increase their volume capacity and associated treatment efficiency providing cleaner effluent on a long-term basis.

	Microbe-Lift	BioAktiv
Initial inoculation 11 Nov, 2007	50 gallons	30 kg
Next 4 weeks	15 gallons/week	10 Kg/week
Thereafter	10 gallons/month	12 kg/month

Fig. 2: *Dosage schedule of recommended treatment.*

Results Achieved: The pond showed dramatic improvement after only four months of treatment.

Fig. 3: *The same pond as shown in figure 1 after four months of treatment shows that the "islands" have been removed and the water is much less turbid (23 October 2007).*

Based on denitrification activity, the pond showed bubbling throughout. The effluent BOD levels dropped 42% from 208 mg/l to 120 mg/l in spite of the added soluble organics released as the sludge layer was degraded. The smell dropped dramatically. The local community was extremely happy and the government regulators were very impressed offering to inform other mills of the potential of this treatment.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14502

WASTEWATER TREATMENT - INDUSTRIAL

14600 CHEMICAL

14601 Paint Manufacturer Utilizes MICROBE-LIFT®/IND to Effectively Resolve Odor Problem

14602 Polymer Manufacturer in Texas Utilizes MICROBE-LIFT®/IND to Improve Effluent Quality

14603 MICROBE-LIFT® Technology Helps Pharmaceutical Plant in Saudi Arabia Avoid Shutdown

The case study results listed above were achieved with MICROBE-LIFT® Technology and products, formulated and manufactured by Ecological Laboratories Inc., with technical support for administering the products provided by Ecological Laboratories Inc., in support of their worldwide representatives.

For more information on MICROBE-LIFT® Technology contact

Ecological Laboratories Inc.

www.EcologicalLabs.com

Made in the USA

Major Paint Manufacturer Utilizes MICROBE-LIFT® Technology to Effectively Resolve Odor Problem

Location: **Glidden Company, Div of SCM Corp. Huron, OH**

Background: Glidden, America's third largest paint company had been experiencing odor problems in their 2 MG lagoon system during the warm summer months at their Ohio plant. With warmer temperatures and high manufacturing level, the system would tend to go anaerobic releasing noxious odors that upset the local community.

Objective: MICROBE-LIFT® formulation was added to the lagoon in an effort to control odor while maintaining efficient waste degradation. The waste stream contained largely coatings and resins.

Results Achieved: An evaluation of the waste treatment system was made and laboratory tests were recommended to determine the toxicity and biodegradability of the waste and sufficiency of nutrients present. Results follow:

Laboratory	No.M286-2-1		
pH	7.16 S.U.	**Sulfide(H_2S)**	1.00mg/l
TNFLT(SS)	39940.00 mg/l	**COD**	38.00 mg/l
Ammonia as N	53.21 mg/l	**Total Chromium**	284.00 mg/l
T. Phosphorus	3.27 mg/l	**Lead**	78.00 mg/l
COD	18380.00 mg/l	**Nickel**	96.00 ug/l

With no serious toxicity problems present and ample nutrients, the waste was subjected to a treatability study by an outside lab to confirm that MICROBE-LIFT® technology could degrade the waste.

Ecological Laboratories' technical representative proposed a treatment plan for MICROBE-LIFT® technology. Initially the dosage prescribed was not sufficient to solve the odor problem. The technical representative worked with Glidden personnel to alter the dosage rate after which the odor problem was completely resolved. Once the proper dosage rate was applied, the septic odor was eliminated.

Paint Manufacturer Utilizes MICROBE-LIFT®/IND to Effectively Resolve Odor Problem

	TREATED AT 5 PPM			TREATED @ 10 PPM			UNTREATED		
	COD	**TSS**	**H_2S**	**COD**	**TSS**	**H_2S**	**COD**	**TSS**	**H_2S**
01/10/1996	18380	39940	116.0	18380	39940	116.0	18380	39940	116.0
01/14/1996	2680	18423	---	3010	1150	---	17440	34820	132.0
01/20/1996	1938	14050	1.21	1011	7000	0.79	16978	28690	151.0
% Reduction	**89.5%**	**54.8%**	**9%**	**94.5%**	**82.5%**	**99.3%**	**7.6%**	**28.2%**	**-30%**

Fig. 1: *This chart demonstrates that the waste was readily degradable by* MICROBE-LIFT® technology.

Ecological Laboratories' technical representative proposed a treatment plan using MICROBE-LIFT® technology. Initially the dosage prescribed was not sufficient to solve the odor problem. The technical representative worked with Glidden personnel to alter the dosage rate after which the odor problem was completely resolved.

Once the proper dosage rate was applied, the septic odor was eliminated within a day. Using a smaller maintenance dose, the system was maintained odor-free for the remainder of the season.

Mr. C. Hoffer, the Glidden Environmental Coordinator, was pleased with the resolution of his challenge by MICROBE-LIFT® Technology and recommends this technology to others. (Testimonial available)

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14601

Polymer Manufacturer in Texas Utilizes MICROBE-LIFT® Technology to **Improve Effluent Quality**

Location: **Polymer Manufacturer, Texas**

Background: A water-soluble polymer manufacturer was having difficulty with an activated sludge treatment system that failed to meet permit limits. The treatment system was designed with an initial flocculation phase, whereby the pH was adjusted to 12 or above, followed by an anaerobic treatment phase, which discharged to a typical aerobic activated sludge treatment process.

Objective: The facility was under pressure to improve the efficiency of treatment in the activated sludge system to meet effluent NPDES limits including COD, BOD, and TSS.

After a complete evaluation of the system, **Ecological Laboratories** technical staff determined that high phenolics in the waste stream, often exceeding 30 mg/l in the aerated basin, was inhibiting microbial treatment. Variation in the form of phenol shocks in the influent provided continual disruptions in both the anaerobic and aerobic systems.

Bioaugmentation with MICROBE-LIFT® technology, a consortium of strains capable of effectively degrading phenolic wastes, was the obvious solution. A program was developed including an initial dosage of 5 ppm dosed into the aerobic digester followed by a 1-ppm daily maintenance dosage.

Results Achieved: The following chart indicates the improvement in effluent quality two weeks after initiation of treatment. The results will continue to improve as the bacteria become more acclimated to the specific waste stream, again showing the cost-effectiveness of the use of bioaugmentation.

Effluent Data	Before	After	Percent Improvement
pH	8.35	7.66	
Alkalinity	5300		
NH_3(N)	33.93	1.28	96%
PO_4 (P)	14.76		
BOD	2689	148	94%
COD	4833	545	89%
TSS	824	128	84%
Cd	0.82		
T. Chromium	0.16		
Copper	0.44		
H_2S	9.60		

Fig.1: *This chart shows a dramatic increase in treatment efficiency based on the introduction of the consortium of strains in* MICROBE-LIFT® technology. *All data is reported in mg/l with the exception of pH.*

Through the bioaugmentation program and some diversion of flow, control was achieved even when the influent concentration of phenol was over 100 mg/l.

In addition, the anaerobic digester had also been disrupted because of toxic conditions. The dosing of MICROBE-LIFT® formulation directly into the primary digester was able to bring the digester back on line much faster than it would recover otherwise.

The use of MICROBE-LIFT® formulation in municipal anaerobic digesters is a well-established beneficial practice. Solids balancing of an anaerobic digester is the primary method of affecting control over these systems. Often this balance is difficult to maintain, especially with the aging and undersized systems and heavily increased solids loading we experience today. Anaerobic digesters handling industrial waste are even more difficult to balance. In this case, heavy metals provide additional toxicity. Application of MICROBE-LIFT® formulation to these systems has demonstrated its ability to quickly restore proper operating parameters, showing increased gas production and overall solids removal efficiency. Although MICROBE-LIFT® technology is sensitive to metal toxicity, the effective use of this bacterial augmentation can overcome these toxic conditions especially if the heavy metal toxicity is cyclical.

The excellent efficiency of MICROBE-LIFT® bacteria to oxidize hydrocarbons makes it particularly effective against complex organic compounds that end up in the digester. In addition, MICROBE-LIFT® technology's affinity for hydrogen sulfide oxidation makes it beneficial in controlling odor problems always associated with malfunctioning anaerobic digester systems.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14602

MICROBE-LIFT® Technology Helps Pharmaceutical Plant in Saudi Arabia Avoid Shutdown

Location: **Al-Hayat Pharmaceutical Manufacturing Company, Jeddah, Saudi Arabia**

Background:

Al-Hayat Pharmaceutical is an old manufacturing facility that was built in 1972. This company produces the following range of products:

(1) Antibiotics: (syrup & tablet) including Ciprofloxacin (broad-spectrum) Clindamycin (gram-positive) Ampicillin (broad spectrum)
(2) Anti-diarrheal product (syrup) a product that contains "Neomycin", a broad spectrum anti-biotic
(3) Dextrose and Saline solutions.

When the plant was constructed in 1972, there was no plan for a wastewater treatment plant. All industrial wastewater was piped out into the city-draining network directly. Almost 30 years later, new regulations required that the wastewater be pre-treated on site before it is allowed to go through the city drainage system. At that point, it was decided to construct a 500 M^3 collection tank, which allows 4.1 days of retention time. The hope was to allow for some of the residuals of antibiotics to precipitate in the bottom of the tank, and cleaner effluent could then be piped to the city drainage system but the system proved unsatisfactory.

On January 10, 2006, a final closure warning letter from the local authorities was received by the top management of Al-Hayat Pharmaceutical stating "Treat your water within the next 60 days or you will be shut down". Two days later, after considering options, the plant maintenance manager, engineer Khalid Al-Hanbali called Nahhas World Business Center for assistance. Nahhas is a distributor for Ecological Laboratories Inc's MICROBE-LIFT® wastewater treatment technology.

Objective:

This plant was given effluent parameters that they must meet to avoid plant shut down. Nahhas agreed to work with Al-Hayat Pharmaceutical to attempt to meet those parameters. Initial Actions Taken:

1. Two samples from influent and effluent were collected and sent to the lab for analysis for COD, BOD, TSS, NO3, and PO4. Results are listed below.

Parameter	Influent	Effluent
COD	45,600 mg/Lt	46,811 mg/Lt
BOD	28,412 mg/Lt	28,315 mg/Lt
TSS	13,490 mg/Lt	8,920 mg/Lt
N-T	0.9 mg/Lt	0.9 mg/Lt
PO_4	62.5 mg/Lt	62.5 mg/Lt

Fig. *1: Initial results show very poor treatment.*

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2. Another sample from influent was taken to Nahhas' in-house lab to determine if the waste will support bacterial growth and what DO level is required. The initial sample showed no bacterial growth. As DO was added to achieve 10 mg/l a bacterial count of 3 million/ml was achieved which was adequate for a start. It was determined that there were insufficient nutrients in the wastewater so nutrients, mainly urea nitrogen, also had to be added.

3. A plan was devised to divide the 500 M collection tank into a four-stage treatment facility to include the following: a 50 M collection tank, followed by a 50 M3 primary clarifier, to a 350 M3 aeration tank, and a 50 M3 secondary clarifier. The daily flow was known to be 120 M3/day.
4. Discussions with local authorities resulted in the extension of their warning period from 60 to 120 days.

The following treatment plan was developed:

Aerators were installed on both the collection and aeration tank resulting in a DO Level of 10 mg/L in both tanks.

A dosage schedule for applying MICROBE--LIFT/IND (ML/IND) was devised as follows:

Day1: Apply 2 gallons ML/IND to the collection tank and 9 gallons ML/IND to the aeration tank. Add 40 kg of urea to the aeration tank and 10 kg of urea to the collection tank.

Days 2, 3, 4, 5 & 6 (daily): Apply 0.5 gallon ML/IND to the collection tank and 2.25 gallons ML/IND to the aeration tank. Add 5 kg urea to the collection tank and 20 kg of urea to the aeration tank.

Every 3 days X 10 times: Apply 1 gallon of ML/IND to the collection tank and 5 gallons of ML/IND to the aeration tank. Add 10 kg urea in the collection tank and 40 kg to the aeration tank.

Maintenance Treatment Plan (weekly):

Apply 1 gallon ML/IND to the collection tank and 3 gallons ML/IND to the collection tank. Add 10 kg urea in the collection tank and 40 kg urea in the aeration tank.

Results Achieved:

Effluent parameters were monitored throughout the treatment program with the goal of meeting the following effluent limits:

COD	1500 mg/l
BOD	500 mg/l
TSS	50 mg/l
Ammonia	5 mg/l (added later)

Significant improvement was seen in the first 30 days of treatment.

Parameter	Starting Effluent	30 days after ML	60 days	90 days	120 days
COD	46,811	31015	15,321	2,701	1200
BOD	28,315	11,326	3,237	1001	480
TSS	8,920	3,121	1007	452	117
Ammonia	---	720	412	201	70

Fig.2: *Results of effluent monitoring shows substantial reductions in all parameters.*

The parameter targets to be achieved were:

The program was successful in achieving the COD and BOD targets in 120 days. Although TSS was still in violation, the plant was allowed to continue and an average of 50 mg/l TSS was achieved in the next 60 days without any extra intervention.

Ammonia was not part of the initial defined parameters. But since it presented as a potential concern during the treatment process, it was added as an additional goal. The ammonia reached a plateau and did not continue to drop. It was decided to reduce urea input and adjust the aeration system to allow a short period of time for denitrification. The aeration system now injects air at 10 mg/l for 120 minutes and stops for 40 minutes, during which time denitrification kicks in. Nitrification in the aerobic phase converts ammonia to nitrate, which is then converted to nitrogen gas during denitrification. Nitrogen gas is returned to the atmosphere eliminating it from the system. Utilizing this process, the ammonia concentration was contained at 5-10 mg/l.

Based on bioaugmentation with MICROBE-LIFT® and the associated system modifications recommended by **Ecological Laboratories, Inc** technical team, this plant avoided shutdown.

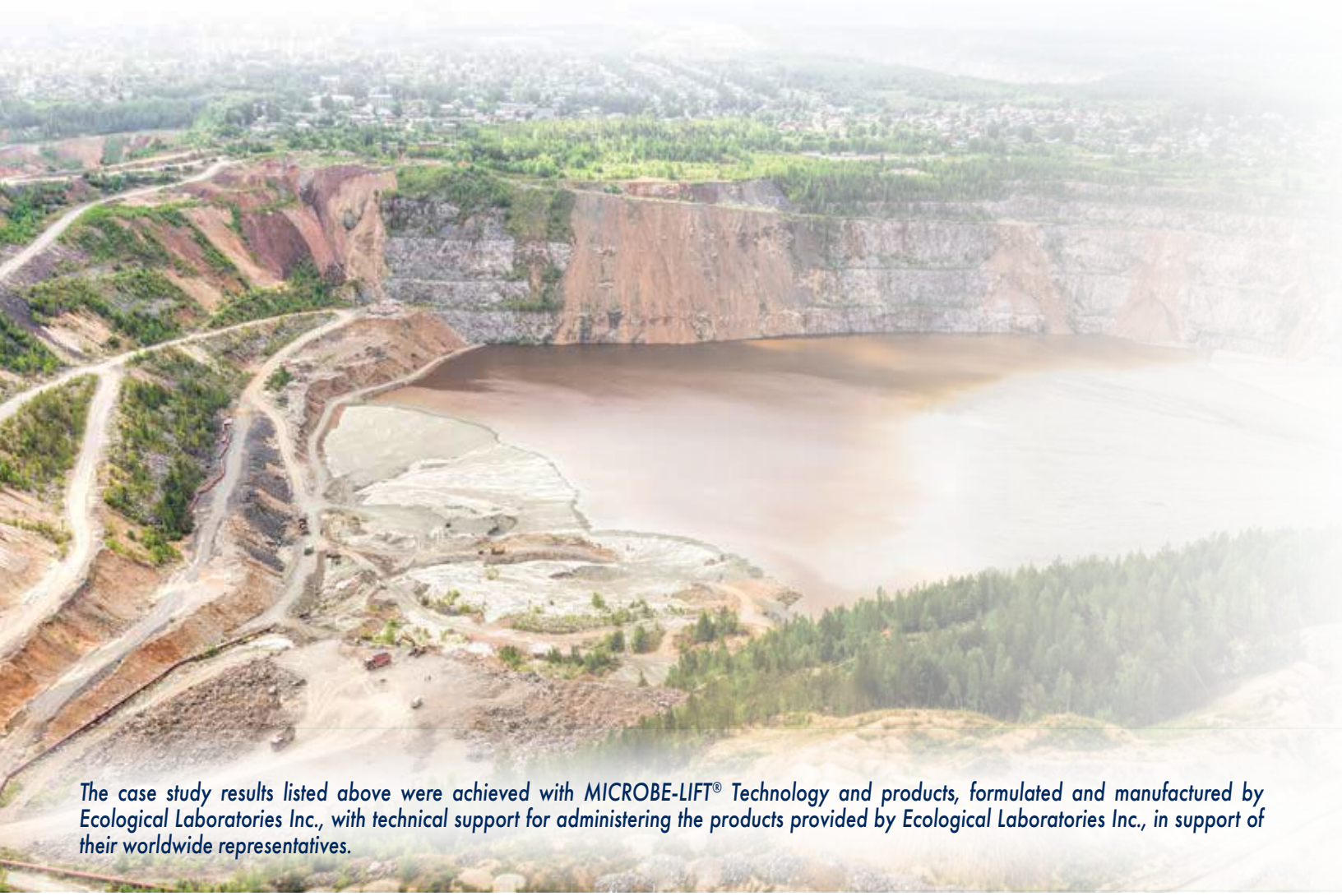
For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
14603

WASTEWATER TREATMENT - INDUSTRIAL

14700 OTHER WASTE TREATMENT APPLICATIONS

14701 MICROBE-LIFT® Technology Reduced Hydrogen Sulfide Odor in Rock Quarry by a Dramatic 86%

14702 Reduction of Odor at Municipal Unitary Enterprise "Vodokanal", Podolsk, Russia



The case study results listed above were achieved with MICROBE-LIFT® Technology and products, formulated and manufactured by Ecological Laboratories Inc., with technical support for administering the products provided by Ecological Laboratories Inc., in support of their worldwide representatives.

For more information on MICROBE-LIFT® Technology contact

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CS14700

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MICROBE-LIFT® Technology Reduced Hydrogen Sulfide Odor in Rock Quarry by a Dramatic 86%

Location: **Limestone Rock Quarry**

Background: A seventy-year-old rock quarry was receiving numerous complaints from local businesses concerning odors being generated by the quarry. This quarry was producing H_2S levels as high as 154 ppm. Attempts had been made to mask the odors with fragrances but the effects had been minimal at best.

Objective: Anxious for a solution, the management agreed to test the efficacy of MICROBE-LIFT® technology, **Ecological Laboratoraies, Inc.** developed a test protocol that recommended dosing product into the second retention basin, a pond with a capacity of 25,000 gallons and daily flow rate of approximately 500,000 gallons per day. The basin was initially charged with a 25-gallon shock dose of MICROBE-LIFT® formulation. A metering pump was then installed and a daily application rate of 25 gallons per day was applied.

Results Achieved: Within 24 hours of the initial application of MICROBE-LIFT®, the H_2S levels were reduced from 154 ppm to 22 ppm for a dramatic 86% reduction. The complaints from local businesses ceased. Pleased with the efficacy of MICROBE-LIFT®, the quarry management continues to apply MICROBE-LIFT® on a daily basis.

For more information on MICROBE-LIFT® Technology contact
Ecological Laboratories Inc.
www.EcologicalLabs.com
CS14701

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Reduction of Odor at Municipal Unitary Enterprise "Vodokanal", Podolsk, Russia

Location: **Municipal Unitary Enterprise "Vodokanal", Podolsk, Russia**

Date of the report: December 1st, 2015
Date of the test:October 22, 23, November 13,14, 2015.

Background: On pilot tests of biological preparations MICROBE-LIFT®/IND and MICROBE-LIFT®/SA at sludge dewatering department in wastewater treatment plants.

The Purpose of the Test:

1. To check the technical capabilities and operating capacity of metering unit for bio-preparation at the sludge dewatering department provided by BTA Group Ltd.
2. To evaluate the bio-preparations MICROBE-LIFT®/IND and MICROBE-LIFT®/SA application efficiency to remove the characteristic odor of sewage sludge (cake) after separation on centrifuge and in its place of storage. Selection of optimum operating dosages of biological preparations MICROBE-LIFT®/IND and MICROBE-LIFT®/SA.
3. To evaluate the possible removal of the characteristic odor of sewage sludge at the sludge dewatering department room using the working solution of biological preparations MICROBE-LIFT®/IND and SA spraying method.
4. To determine the preferred specific consumption of biological preparations MICROBE-LIFT®/IND and SA mixture and to process sludge in ratio - liter / m^3 (a mixture of biological preparations, rather than its solution).

Original data

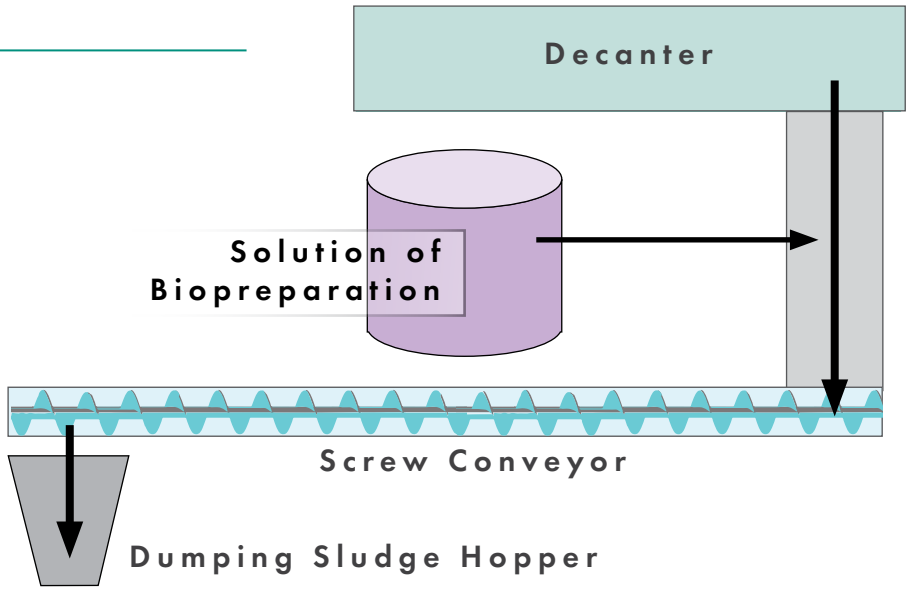
Type of initial sludge: a mixture of raw sludge from primary settlers and compacted surplus activated sludge (in the current working ratio).
Equipment: Screw conveyor and the decanter (centrifuge) for sludge dewatering Flott weg C4E-4/454 HTS, preparation metering unit.

Test procedure

Industrial tests of biological preparation MICROBE-LIFT®/IND and MICROBE-LIFT®/SA

- Bio-preparations MICROBE-LIFT®/IND and MICROBE-LIFT®/SA were mixed in a ratio of 1:1. Further, by diluting the resulting mixture in non-chlorinated water, the solutions of the following concentrations 3.5% and 2% were prepared. Solutions were prepared in a polyethylene tank in a total volume of 200 liters each.
- The solution was fed to the conveyor by the metering pump in a volume of 7,5 l per 2.65 m cake/h
- The total volume of solution used is ~ 600 liters, including biological preparations in concentration of 3.5% - 200 liters and with biological preparations in concentration of 2% - 400 liters;
- The total volume of processed cake - 212 m^3;

Test pattern is shown:



Test results are shown in Table:

Concentration of the mixture of biopreparations in solution. %	**3.5 %**	**2 %**
Bio-preparation rate l/m3 wastewater treatment	0.1	0,06
Odor at the outlet of the conveyor in the hopper compartment	Imperceptible 0 point	Too faint 1 point
Odor near to the storage site in 20 days	Too faint 1 point	Faint 2 points
Odor in the department within the period of biopreparations application	Too faint 1 point	Faint 2 points

In addition to the above results, it was indicated that after spraying a solution of bio-preparations in the sludge dewatering department room (total volume of 10 liters of the solution to the entire area of the department), the intensity of the characteristic odor of sludge in this room has been significantly reduced.

It should also be noted that storage of dewatered sewage sludge (cake) stored and processed by biological preparations was made under the weather conditions, characterized by high humidity with precipitation and average air temperature from + 2 to + 7 during a day and at night to -2 . The effectiveness (aftereffects) of the biological preparations MICROBE-LIFT®/IND and MICROBE-LIFT®/SA at lower ambient temperatures below + 4 and air access restriction (including due to high humidity), as a rule, is reduced. Under the conditions of dry and warm weather, the effectiveness (aftereffects) of the biological preparations in the stockpiled sludge (cake) is significantly higher (this, in particular, is evidenced by the experience of making similar tests with the processing of dewatered sewage sludge (cake) on Shchelkovo inter-district treatment plants in July 2015).

Reduction of Odor at Municipal Unitary Enterprise "Vodokanal", Podolsk

Summary:

Based on the industrial tests, all tested solutions of mixture of biological preparations MICROBE-LIFT®/IND and MICROBE-LIFT®/SA showed strong results in the removal of odor from the resulting sludge.

The most preferred specific consumption of mixture of biological preparations MICROBE-LIFT®/IND and MICROBE-LIFT®/SA for sludge treatment should be regarded as the ratio of 0.1 liter / m^3 (a mixture of biological preparations rather than its solution).

It is advisable to periodically process the plant premises by spraying the solution of biological preparations

Conclusions:

The solution of biological preparations such as MICROBE-LIFT®/IND and MICROBE-LIFT®/SA in a ratio of 1/1, in the total concentration of 3.5% may be recommended to reduce the intensity of the characteristic odor of the cake at the mechanical dewatering department room in order to prevent the spread (blocking) of the odor during transportation and storage of dewatered sewage sludge.

It is advisable to enter the cake processing procedure using the solution of bio-preparations MICROBE-LIFT®/IND and MICROBE-LIFT®/SA to the Rules and Procedures of the sludge dewatering department.

It is recommended to Company "BTA Group" to prepare a commercial offer for the MUE "Vodokanal" Podolsk for supply and use of preparations MICROBE-LIFT®/IND and MICROBE-LIFT®/SA with the following initial data:

- Hourly average volume of dewatered sludge (cake) formation- from 3.0 to 3.3 m3;
- Annual formation of dewatered sludge (cake) - 20 498 m3;
- Average moisture of formed sludge (cake) - 75.6%;
- The volume of dewatered sludge accumulated in the storage area - 29 227 m3.

For BTA Group Ltd. For MUE "Vodokanal" Podolsk
A.V.Vershinin
S.V.Kalinovski

For MUE "Vodokanal" Podolsk
Eryomina N.F.
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