

## Case Study: Restoring Eutrophic Pushkar Sarovar via Micro Bubble Aeration



Pushkar Sarovar - Fish Kill of September 2008



Pushkar Sarovar - January 2009 - 69 Days into Aeration

**India South Zone:** #536, Jal Vayu Towers, NGEF Layout, Indiranagar P.O., Bangalore 560 038.

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**USA:** Tel: +001 916 995 9024 | [amrandhawa@gmail.com](mailto:amrandhawa@gmail.com)

[www.lakeandriverrestoration.com](http://www.lakeandriverrestoration.com)

**Customer Profile:**

<b>Customer Name</b>	Ajmer Development Authority
<b>Address</b>	Todarmal Road, Civil Lines
<b>City, State, PIN Code, India</b>	Ajmer, Rajasthan, 305001, India
<b>Phone Number</b>	+91 145 262 7748
<b>Website Address</b>	<a href="http://www.uitajmer.org/">http://www.uitajmer.org/</a>

**Case Study - Utilization of 3/4 inch Canadian Pond Micro Bubble Tubing in a Hyper-Eutrophic Setting**



Pushkar Sarovar - Fish Kill of September 2008

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### About Pushkar Sarovar:

Pushkar is a small town of about 14,000 people, developed around the Pushkar Sarovar and the associated Brahma Temple. The total size of the Pushkar Lake is 4.5 hectares, and was about 2 meters in water depth until reaching the start of the 1 – 2 meters of benthic muck in 2008. 12 km Northwest of Ajmer, the geographical location of Pushkar Sarovar is at latitude 26 degrees and 27' North and longitude of 74 degrees 37' east at 530 meters above mean sea level.

The south eastern side of Pushkar is in the Thar Desert, which is adjacent to the Nag pahar that forms a barrier between Pushkar and desert. The location of Pushkar Sarovar is within a valley between two hill ranges; thus, the lake receives surface water runoff from its valley catchment which is about 36.71 Square Km.

### Religious Significance of Pushkar Lake:

Pushkar Lake is one of the most sacred lakes of the Hindu Religion. The ancient Hindu scriptures describe as Pushkar Sarovar as "Tirtha-Raj" – the king of pilgrimage sites related to a water-body and related to the mythology of the creator-god Brahma, whose most prominent temple stands in Pushkar. The Pushkar Lake finds mention on coins as early as the 4th century BC.

### Scientific Water Quality before Aeration:

#### S.No. Parameters

1	Surface Dissolved Oxygen (mg/L)	1.6
2	Bottom Dissolved Oxygen (mg/L)	0.0
3	pH	8.6
4	BOD (mg/L)	49
5	Turbidity (NTU)	89

### Technical Situation:

Being that Pushkar is one of the oldest currently inhabited cities in India; it is safe to reason that organic offerings have been made into the lake for thousands of years. Thus, the solution had to be engineered to deal with over a meter of organic benthic material that had accumulated over centuries. This organic benthic material had to be oxidized in order to fix the Oxygen Reduction Potential of the lake, and thus allow the rise the Dissolved Oxygen throughout the water column. This had to be achieved without stirring this benthic material at

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the bottom of the lake, which if stirred would have drastically reduced the already poor water quality.

### **Government Situation:**

Historically, Pushkar Lake would stink once in a while when the water was especially stagnant and warm, while the clarity of water and the water quality itself has been poor for decades. As Pushkar Lake is a holy one, Hindu pilgrims would bathe with phosphorus soap and drink the dubious water, which would cause them to become infected with various diseases and then fall very ill. Furthermore, as a holy Hindu lake with the only Brahma temple in the world, pilgrims would give offerings in the Hindu tradition by pouring milk and grain into the lake. This milk and grain, which is essentially organic matter, along with rain after a dry spell (the first flush), would bring in pollution from all the surrounding urban development which would cause periodic fish kills. The dire state of the lake along with the increasing numbers of pilgrims falling ill from the dubious water had become quite the embarrassment for the local government and the town itself. The situation became dire when in September of 2008 a massive fish kill occurred. The government asked us to immediately save the lake, as detailed in the next section.



Pushkar Sarovar - Fish Kill of September 2008

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Appreciation Letter from the Government:

॥ श्री ब्रह्म पुष्कर विजयते ॥

पंजीयन सं० 1 अजमेर 1994

श्री पुष्कर तीर्थ सेवा संस्थान, पुष्कर (अजमेर)

(पवित्र सरोवर की सफाई एवं सांस्कृतिक गरिमा की रक्षार्थ)

(देवस्थान विभाग द्वारा पंजीकृत ट्रस्ट)

सत्य सदन, पुष्कर - 305022

दिनांक 27-12-1990

To

M/S Randhawa Brosons  
Enterprises

Through: M/S Verma Trading Corporation,  
Kheiland Market, AJMER.

Dear Sir,

This is well-known fact that, wayback in the last week of Sept. 008, sudden panic spread in Pushkar town due to death of lakhs of Fish of pious Pushkar Lake on account of increasing pollution of water of lake and lack of oxygen in <sup>it</sup> water. Local residents as well as pilgrims and tourists were also scared. In such a grave situation The Distt. Administration procured your expertise/services and we are pleased to say that you took quick action and put tremendous efforts for cleaning the water through aeration and restoring <sup>quantity</sup> amount of oxygen in water as was the sheer necessity, through applying local and foreign technology. With the result water became clean and worth for taking bath by the pilgrims. Besides, there was not a single instance of fish-death <sup>since then</sup> and smell of water also disappeared due to your expert operation.

We are happy to congratulate you for your commendable job and appreciate your spirit of ~~wixx~~ work.

Thanking you ,

with best wishes,

Yours Sincerely

*Janardan Sharma*  
( Janardan Sharma )

Secretary &

Ex-Chairman of Municipal Board,  
Satya Seden, Pushkar.

### **Solution:**

To create a solution that would dramatically increase the Dissolved Oxygen while not churning the benthic material at the bottom of the lake, we decided to use Canadian Pond's ¾ inch micro bubble tubing as the main technology. We then engineered the aeration system solution to meet the specific requirements at Pushkar Sarovar.

### **Products and Services:**

- Proposed, Installed, and Commissioned.
- 600 feet of Canadian Pond ¾ inch Micro Bubble Tubing.
- Oil Free Compressor.
- All Electrification, Plumbing, etc.
- 3 years Operation and Maintenance.

### **Benefits:**

Post Aeration, we received no reports of the usual people falling ill after drinking the water or bathing in the lake. More so, the visibility of the water cleared up dramatically after a few months, to where one could see the sandy bottom; whereas, before aeration one could not see an inch into the water due to pollution and cyanobacteria. The local people, priest, pilgrims, and tourist all enjoyed the newly aerated Pushkar Lake, as it did not smell of sewage, nor did it smell anaerobic digestion as clearly stated in the appreciation letters by the Municipality Customer (page 5) and the Congress Party (page 9 & 10).

### **Results:**



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**Scientific Results for the Bottom and Surface Water:**


**TEAM TEST HOUSE**  
( Unit of TEAM Institute of Science & Technology Pvt Ltd )

Approved under Environment (Protection) Act, 1986 vide MoEF, GOI .SO No2031 (E)  
Dt. 27-11-2006

**Off:** E-65, Chitrangan Marg, C-Scheme,  
Jaipur, Rajasthan-302001.  
Ph. 0141 -2372472,4006118  
E-mail: [teamtest@rediffmail.com](mailto:teamtest@rediffmail.com)

**Lab:** G1-584, RIICO Industrial Area,  
Sitapura, Jaipur, Rajasthan-302022  
0141-2173533  
Website: [www.teamtesthouse.com](http://www.teamtesthouse.com)

**TEST REPORT**

Report No	: WW/482
Date	: 12/01/2011
Issued to	: RUIDP, PIU, Pushkar
Type of Unit	: Pushkar Sarovar, Pushkar
Date of Sample Collection	: 22/12/2010
Date of Sample Receipt	: 23/12/2010
Date of Test	: 23/12/2010 to 11/01/2011
Type of Sample	: Grab
Sample Collected By	: Mr. Mohammad Shakir Gouri
Point of Collection	: Bottom Water of Pushkar Sarovar
Testing Protocol	: American Public Health Association 21 <sup>st</sup> Edition,2005

**RESULTS**

S. No.	Parameters	Observed Values			
		Jaipur Ghat (PW1B)	Varah Ghat (PW2B)	Gau Ghat (PW3B)	Kota Ghat (PW4B)
1	Ambient Temperature ( ° C )	24.6	24.7	24.7	24.8
2	Water temperature ( ° C )	20.9	21.3	20.8	21
3	Water Color Hazen	14	18	20	22
4	pH	8.13	7.51	7.57	8.2
5	Conductivity (µmho/cm)	288.3	364.5	491.1	232.2
6	Turbidity (NTU)	5	9	21	9
7	Total Suspended Solids (mg/l)	21	16	33	13
8	Total Dissolved Solids (mg/l)	174.9	219.4	295.7	139.6
9	Chloride as Cl (mg/l)	20.43	16.72	31.58	14.86
10	Oxidation-Reduction-Potential (mV)	56	42	52	38
11	Dissolved Oxygen (mg/l)	7.4	7.1	7.2	7.1
12	Biochemical Oxygen Demand (mg/l) (5 days at 20 <sup>o</sup> C)	2.9	3.1	4.2	3.3
13	Chemical Oxygen Demand (mg/l)	28.56	18.48	16.8	25.92
14	Total Organic Carbon (mg/l)	9	9	12	3
15	Sulphate as SO <sub>4</sub> (mg/l)	16.75	7	16.75	13.5
16	Fluoride as F (mg/l)	0.34	0.37	0.36	0.37
17	Total Nitrogen as N (mg/l)	45.63	14.96	8.56	15.63
18	Nitrate as NO <sub>3</sub> N (mg/l)	15.23	5.23	3.65	3.02
19	Nitrite as NO <sub>2</sub> (mg/l)	14.25	5.63	4.56	12.35
20	Total Phosphorus as P (mg/l)	0.49	0.74	0.52	0.65
21	Phosphate (Inorganic) as PO <sub>4</sub> (mg/l)	0.1	0.15	0.1	0.1
22	Phosphate (organic) as PO <sub>4</sub> (mg/l)	1.4	2.1	1.5	1.9

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## TEAM TEST HOUSE

( Unit of TEAM Institute of Science & Technology Pvt Ltd )

Approved under Environment (Protection) Act, 1986 vide MoEF, GOI .SO No2031 (E)  
Dt. 27-11-2006

**Off:** E-65, Chitrangan Marg, C-Scheme,  
Jaipur, Rajasthan-302001.  
Ph. 0141 -2372472,4006118  
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**Lab:** G1-584, RIICO Industrial Area,  
Sitapura, Jaipur, Rajasthan-302022  
0141-2173533  
Website: [www.teammtesthouse.com](http://www.teammtesthouse.com)

### TEST REPORT

Report No : WW/481  
Date : 12/01/2011  
Issued to : RUIDP, PIU, Pushkar  
Type of Unit : Pushkar Sarovar, Pushkar  
Date of Sample Collection : 22/12/2010  
Date of Sample Receipt : 23/12/2010  
Date of Test : 23/12/2010 to 11/01/2011  
Type of Sample : Grab  
Sample Collected By : Mr. Mohammad Shakir Gouri  
Point of Collection : Surface Water of Pushkar Sarovar  
Testing Protocol : American Public Health Association  
21<sup>st</sup> Edition,2005

### RESULTS

S. No.	Parameters	Observed Values			
		Jaipur Ghat (PW1S)	Varah Ghat (PW2S)	Gau Ghat (PW3S)	Kota Ghat (PW4S)
1	Ambient Temperature ( ° C )	24.4	24.5	24.5	24.6
2	Water temperature ( ° C )	21.4	20.9	21.1	21.5
3	Water Color Hazen	15	16	18	20
4	pH	7.9	7.36	7.26	7.71
5	Conductivity (µmho/cm)	325.4	378.3	502.8	237.1
6	Turbidity (NTU)	13	5	10	17
7	Total Suspended Solids (mg/l)	38	14	20	25
8	Total Dissolved Solids (mg/l)	181	230.4	303.1	146.3
9	Chloride as Cl (mg/l)	14.86	14.86	38.43	16.72
10	Oxidation-Reduction-Potential (mV)	45	52	58	32
11	Dissolved Oxygen (mg/l)	8.2	7.6	7.2	7.6
12	Biochemical Oxygen Demand (mg/l) (5 days at 20 <sup>o</sup> C)	1.6	1.7	3.4	3.1
13	Chemical Oxygen Demand (mg/l)	21.84	13.44	20.16	20.16
14	Total Organic Carbon (mg/l)	12	15	21	15
15	Sulphate as SO <sub>4</sub> (mg/l)	13.5	7	16.75	13.25
16	Fluoride as F (mg/l)	0.4	0.4	0.35	0.37
17	Total Nitrogen as N (mg/l)	12.56	26.35	32.30	22.36
18	Nitrate as NO <sub>3</sub> N (mg/l)	5.63	19.36	5.63	16.35
19	Nitrite as NO <sub>2</sub> (mg/l)	5.02	2.96	18.36	5.63
20	Total Phosphorus as P (mg/l)	0.52	0.4	0.65	0.41
21	Phosphate (Inorganic) as PO <sub>4</sub> (mg/l)	0.25	0.1	0.1	0.1
22	Phosphate (organic) as PO <sub>4</sub> (mg/l)	1.35	1.1	1.9	1.15
23	Oil and Grease (mg/l)	5	6	4	5

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Appreciation Letter from the Congress Party:



23793447, 23019080  
एक्स : 405  
मोबाईल : 09828873430

## अखिल भारतीय कांग्रेस कमेटी

(कांग्रेस अध्यक्ष का कार्यालय)

“कवि” सोहनदान चारण  
कांग्रेस का राष्ट्रीय कवि एवं राष्ट्रीय स्टार प्रचारक

24 अकबर रोड़  
नई दिल्ली-110011

### प्रशंसा पत्र

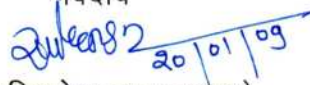
श्री सतविन्दर पाल सिंह रंधावा, वैज्ञानिक अमेरिका (रंधावा ब्रोसन्स एण्टरप्राइजेज), के उल्लेखनीय अतिविशिष्ट कार्यों पर हमें गर्व है।

यह है कि पुष्कर तीर्थ के सरोवर का पवित्र जल जिसमें वर्षों से अस्थिराँ, पुष्प, दाना आदि आस्था से जुड़ी सामग्री विसर्जित होती आने से उक्त जल में ऑक्सीजन की कमी आ गई और पानी प्रदूषित हो गया था, कार्ब एवं लील पानी में मिली हुई दिखाई देने लगी, जिससे पानी की पारदर्शिता बिल्कुल कम हो गई एवं नतीजा यह निकला कि दि.26 एवं 27 सितम्बर, 2008 को उक्त सरोवर की एक लाख से अधिक मछलियाँ मर गई एवं उनकी दुर्गन्ध दो किलोमीटर तक सम्पूर्ण पुष्कर शहर में फैल गई थी।

यह है कि आपने उक्त जल को बिना कोई रासायनिक पदार्थ डाले साफ करने का दृढ़ संकल्प लिया एवं प्रशासन के आर्थिक सहयोग से 26.10.08 को आपने सरोवर की सफाई का काम शुरू कर दिया एवं लगभग ढाई महिनोँ में ही आपने अपनी वैज्ञानिक तकनीक से उक्त जल को स्वच्छ अमृतमय कर दिया जिससे आज सरोवर का पैदा जल के अन्दर से स्पष्ट दिखाई देने लग गया है। इस साहसिक सफल प्रयास के लिए मैं आपका भारत राष्ट्र की पवित्र पुष्कर तीर्थ नगरी में हृदय से स्वागत करता हूँ।

यह है कि युवा कार्यक्रम एवं खेल मंत्रालय, भारत सरकार के नेहरू युवा संगठन व उत्सव मंच द्वारा आपको दि.19.01.09 को सम्मानित किया गया है उसकी बधाई देता हूँ एवं आपके उज्ज्वल भविष्य की कामना करता हूँ।

अजमेर  
दिनांक 20.01.2009

भवदीय  
  
(कवि सोहनदान चारण)

निवास दिल्ली : 91, साउथ एवेन्यू, नई दिल्ली, फोन : 011-23019832  
निवास राजस्थान : मुकाम-भूतास, पोस्ट-पीलवा, जिला-नागौर (राज.) मो.: 09829905329

**Literal English Translation of Letter Above from the Congress Party:**

The Real Indian Congress Committee  
(Congress Committee Head Office)

Sohandas Charan  
National Congress Poet

24 Akbar Road  
New Delhi - 110011

Appreciation Letter

Mr. Satvinder Pal Singh Randhawa  
American Scientist  
Randhawa Brosons Enterprises

We are proud of the exceptional work done by him, this is to say, that Pushkar Sarover, which is a pilgrimage site in which the worshipers would put grain and various organic materials into the water causing a total depletion of oxygen, resulting in algal scum being observed in the water. This caused the water to be totally unsupportive of all life forms, resulting on the 26 and 27 of September 2008 a fish kill of over 100,000, which caused a foul smell that engulfed the town of Pushkar.

This is to say that this is the same water without the application of any chemicals, with the involvement of the authorities you started your project on 26 of October 2008, and in approximately 2 and a half months you purified the water with your scientific approach, and today you can see clearly into water. This is an extremely successful job for the number one pilgrimage spot of India, for which we give you our heartfelt welcome to the town.

The Youth Congress Committee, on 1 January 2009 facilitated you by giving you a certificate for the exceptional job done, and we wish a very bright future.

Signed (Sohandas Charan) 20.01.2009

**About Randhawa Brosons Enterprises:**

Randhawa Brosons Enterprises, founded in 2006, has already been competitively selected to engineer, install, commission, and operate/maintain seven bottom aeration and bioremediation projects in India. The company's projects span from the high mountain waters of Lake Nainital in Uttarakhand to the arid hills of Pushkar Sarovar in Rajasthan and the fertile banks of the Yamuna Jheel in Lucknow. Randhawa Brosons is dedicated to returning the health to India's endangered aquatic ecosystems using organic scientifically proven methods and advanced technologies.

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