

Bio-Remediation of Petroleum Sludge with EM Technology (a Safe Disposal-Method)

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oily sludge.

them.



DR.A.SYED (EMRO PAKISTAN) ON BEHALF OF DR.CARLOS OF UNIDO



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

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Reference : PRO 300/EM Tech

21 October 2003

Subject: 2nd International EM Technology Conference in Okinawa, Japan,
15-16 November 2003

Dear Dr. Higa,

Thank you very much for your kind invitation extended to me to participate in the subject Conference which is scheduled to be held in Okinawa, Japan from 15 to 16 November 2003.

Since EM technology is being effectively implemented in UNIDO/EMRO project where trial carried out on In-situ bioremediation of ARL oily sludge using EM Technology as well as other experience in leather industry I am convinced that it is providing effective results. EM technology is also creating awareness in Pakistan for a better future of humanity and is very helpful in solving common environmental problems using natural resources available in our environment.

It was my keen desire to attend the subject conference to gain more knowledge and awareness about EMRO, however, due to some unexpected commitment at our Headquarters in Vienna I regret that I will not be able to attend this important conference as, personally, I was very much interested to visit EM Headquarters in Japan. I do hope, however, that I can have the opportunity to visit your organization at a later stage.

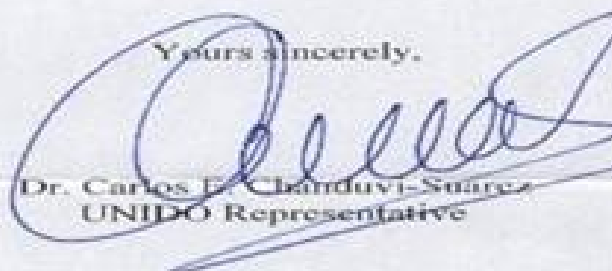
In view of the above I wish to express my gratitude towards EMRO which is doing tremendous efforts in solving environmental problems in the world.

Thank you for your cooperation and am looking forward to meeting you in due course of time.

At the end I apologize for any inconvenience caused.

With best regards,

Yours sincerely,



Dr. Carlos E. Chaudry-Suarez
UNIDO Representative

Dr. Teruo Higa
EM Research Organization
2-9-2 Ganeko Ginowan
Okinawa (JAPAN)

THE LETTER FROM DR.CARLOS TO DR.HIGA

Objectives:

- **Industry needs a well planned sludge management system.**
- **Sludge poses various kinds of environmental hazards like:**
 - **liable to catch fire**
 - **groundwater contamination**
 - **soil contamination**
 - **threat to marine life**
 - **air pollution & odor**
- **EM with all its advancements made since its development has the potential of bio-degradation (anaerobic & aerobic) of most types of wates/sludges**
- **Carrying out application of EM which is:**
 - **result oriented on the basis of:**
 - cost- effectiveness**
 - reduce/eliminate toxicity**
 - safely-disposable**
 - by-product**
 - easy to handle**
 - no hazardous residues**

United Nations wish to provide a cost effective better solution to the petroleum industry from its platform

Attock Oil Refinery Limited



Crude Capacity : 35,000 B/D

**Products : LPG, Gasoline, Kerosene, HSD, LDO,
FO, Asphalt, JBO, MTT, Solvent Oil, etc.**

**Producing 440t/d waste water
& 800MT/y Petroleum Sludge**

THE 2ND LARGEST OIL REFINERY IN PAKISTAN

Original Sludge (before treatment)



OIL SLUDGE. SIMPLY DUMPED WITHOUT PROPER TREATMENT

Research Design

- Phase I
 - To test the efficacy of EM Technology in Bio-remediation of petroleum waste In-situ
- Phase II
 - Conduct R&D in Horticulture, Floriculture and Agriculture to prove its efficacy
- Phase III
 - To test the toxicity in the crop and the soil

Properties of Sludge before treatment

- Organic Matter = 65.1% TPH = 97%
- pH = 6.7

Color: Black Smell: HC strong smell

Heavy Metal Analysis		&	NPK Value
Ba	2570ppm	N	0.83%
Pb	200ppm	P	0.0584%
Fe	34430ppm	K	0%
Zn	1440ppm		
Ni	90ppm		
Cu	50ppm		
Mn	220ppm		
Cr	24ppm		
As	29ppm		

Highly Toxic and Hazardous for Humans, Animals, Plants, Soil, Ground Water, Air & Environmental Health

Material & Method (Phase-1)

- Quantity of Sludge = 1.72 Tons**
- Big plastic sheets to cover the sludge(to maintain anaerobic conditions)**
- Different types of EMs in different ratios**
- The maximum potential of microorganisms is achieved between 30-40°C**
- Moisture up to 30% in the presence of sufficient organic matter.**

Anaerobic Fermentation



Mixing different types of EMs



Microbial Activity



after 3 weeks



after 6 weeks



after 8 weeks



Mice Experiment

Is this not a proof of complete conversion of toxic sludge into an eatable sludge!!





A pair of rats enjoying EM treated sludge as food

Conclusion

- The EM-microorganisms changed the physical & chemical properties of oily sludge
- It was no more a massive mass but brittle in small aggregates, it was therefore, easy to handle
- It was considered no more dangerous to workers and safe to transport
- Oily sludge was considered to be ready for use in floriculture, horticulture & agriculture
- Phototrophic bacteria produced Protein even in the oily sludge.
- EM de-ionized the harmful elements and detoxified them.

Comparison of Oily Sludge before and after EM Treatment

Parameters	Before	After	Change
N	0.83%	6.8%	719% (i)
P	0.0584%	0.0748%	28% (i)
K	0%	0.0384%	4% (i)
OM	65.1%	5.1%	92% (d)
Ba	2570ppm	191ppm	93% (d)
Pb	200ppm	42ppm	79% (d)
Fe	34430ppm	8686ppm	75% (d)
Zn	1440ppm	382ppm	73% (d)
Ni	90ppm	26ppm	71% (d)
Mn	220ppm	103ppm	53% (d)
Cu	50ppm	21ppm	58% (d)
Cr	24ppm	13ppm	46% (d)
As	29ppm	18ppm	38% (d)

 Increase
 Decrease

VALUE OF N,P,K INCREASED AND HEAVY METALS DICREASED

IIInd Phase

At the end of eighth week

- Pot experiment:
 - 20kg of sludge for preliminary pot experiment
 - 2 pots of control & 2 pots of sludge+soil mix (1:1)
- Field experiment:
 - Treated 2 ton of oily sludge for agro use

Recommendations:

- Soil analysis as per agro parameters before & after treatment
- Plant and grain analysis

Pot Experiment



SLUDGE AND SOIL MIXED AT 1:1

Agricultural application (Onion & Turnip)



Before Application



Control



Treatment



Field parameters		
Parameters	EM Treatment	Control
Plotted Area	64x20 feet	64x20 feet
Yield enhancer added	EM 920kg (1:1) added	FYM 920kg added
Transplantation	2,673 nursery	2,673 nursery

Field enhancer	Samples required to check the toxicity
Bio-fertilizer	Onion, Soil, bio-fertilizer
Manure	Onion, Soil, manure
Naturally occurring soil was also tested for its toxicity as control	

Treatments	Yield (Kg)	Remarks
Control	275 Kg	Plant growth was ok and their leaves were greenish at the time of cultivation as compared to those grown in EM treated plot
EM Treatment	230 Kg	Plant growth was good and the onions harvested were larger in size as compared to those grown in FYM treated plot

IT WAS AMAZING THAT WE COULD GET 230 KG OF VEGETABLES BY USING ONCE TOXIC SLUDGE

Dry Ashing for Micro Nutrients

Cations of Plants

- Plant analysis by Dry ashing is simple, non-hazardous and less expensive compare with HNO_3 , HClO_4 wet digestion. Dry ashing is appropriate for analyzing all macro and micronutrients in plant tissues.
- Procedure:
 - 1. Place 0.5 to 1.0 gram portion of plant material (onion) in a glass beaker.
 - 2. Place the beaker in cool muffle furnace and increase the temperature gradually to 5500C .
 - 3. Continue ashing for 5 hours after attaining 5500C .
 - 4. Shut off the muffle furnace and open the door cautiously for rapid cooling.
 - 5. When cool, take out the beaker carefully.
 - 6. Dissolve the cool ash in 5 ml portion of 2 N HCl and mix with the glass rod
 - 7. After 15 to 20 minutes, make up the volume (usually 50 ml) using 0.1 N HCl.
 - 8. Mix thoroughly, allow standing for about 30 minutes, and filtering it.
 - 9. Analyse the sample by using Atomic absorption spectroscopy.

Subsequently testing was conducted using atomic absorption spectrophotometry

Analysis for Micronutrients And Heavy Metals

For soil, the samples were prepared by the following method:

- **Apparatus required:**
 - i. **Reciprocal shaker**
 - ii. **Atomic absorption spectrophotometer**
- **Reagents:**
 - i. **Diethylenetriaminepenta acetic acid (DTPA).**
 - ii. **Standard Solutions.**
- **Procedure:**
 - i. **Take 10 g soil sample.**
 - ii. **Add 20 ml of DTPA (Diethylenetriaminepenta Acetic Acid).**
 - iii. **Shake this solution for 15 min.**
 - iv. **Filter the solution and analyse using Atomic Absorption Spectrophotometry**

Micronutrient conc. in original soil, EM treated soil and in FYM treated soil

Micronutrients	Original soil	EM treated soil	FYM treated soil	Permissive level
Iron (Fe)	2.8	4.4	7.13	2.0–8.0ppm
Zinc (Zn)	ND	1.43	2.1	5.0ppm
Manganese (Mn)	24.7	10.2	8.1	>1.0ppm

**Source NEQS and Soil Science Book National Book Foundation 1996*

Heavy metals content in Soil taken from EM treated area and FYM treated area:

<i>Heavy metals</i>	<i>FYM soil</i> <i>ppm</i>	<i>Treated sludge (1:1)</i> <i>ppm</i>	<i>Permissible limit</i> <i>(ppm) *</i>
Chromium (Cr)	0.04	0.07	1.0
Cadmium (Cd)	0.17	0.14	>1.0
Copper (Cu)	0.03	1.05	3.0-5.0
Nickle (Ni)	0.45	0.32	1.0
Lead (Pb)	2.0	1.57	15–20

**Source for Permissible limits: NEQS and Department of Plant & Soil Sciences Laboratory*

Symposium on Petroleum Bio-remediation with EM Technology at UN/NCPC Islamabad



Economic Evaluation *for a safe disposal*

- Incineration : ~1200 US\$/ton
- Washing : ~300 US\$/ton
- Bioremediation : ~200 US\$/ton

However,

- a) Only disposal (not 100% safe disposal)
- b) No reuse
- c) No by-product
- d) Ash, Dioxin, emission gases, waste water, chemicals, etc.

- While with EM : very cheap (cost effective)

And also,

- a) 100% safe disposal
- b) Reuse
- c) By-product (sale able)
- d) No residues, no emissions, no chemicals, etc.

We offer @US\$120/ton of petroleum sludge bioremediation safe disposal

<http://www.un.org.pk/unido/npc/Project%20Proposals.htm>

<http://www.embiotech.org>

**EM TREATMENT IS PROVEN AS THE MOST ECONOMICAL
AND SAFE METHOD**

Karachi Oil Spill

Beaches (7km) and Open Waters (20km) of Arabian Sea Cleaning Project

Cleaning of beaches: (Phase-I)

- US\$300,000 (¥36million)
- Funded by UNIDO & UNDP
- Starting 1st week of December 2003
- Collaboration with EMRO Pakistan

THANK YOU

JAMOF SDN BHD