

# REPORT ON BIO REMEDIATION OF SLUDGE

HINDUSTAN PETROLEUM CORPORATION LTD.,  
VASHI TERMINAL,  
NAVI MUMBAI, INDIA



OIL FIELD TEKNIKS

# REPORT ON BIO REMEDIATION OF SLUDGE

*PO Number 600024-OP-11588*

*Industry*

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## **ACKNOWLEDGEMENTS**

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**C.V.Rao**  
Managing Partner  
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## **Objective**

Bio-remediation of 120 Kilolitres of sludge, retrieved from tank bottom and stored in pits. To bring down the Oil & Grease percentage to 1%.

## **Method**

Enhanced Bio Remediation using natural bacteria on site

## **Result**

Bioremediation is successfully completed and the sludge has been converted as manure. Plant growth has commenced on the treated sludge inside the pit.

Date of initiation	: 9th October 2006
Date of completion	: 17th July 2007
Date of 1st plant growth noticed	: 25th February 2008
Date of Last sample collected	: 7th March 2008

## **Laboratory Analysis**

Reports of analysis conducted at various stages of the project are appended.



## Summary

Tank bottom Sludge has been stored in pits inside the tank farm. HPCL has allotted the job of Bio remediation of this sludge to Oil Field Teknics.

A site for the Bioremediation pit has been earmarked by the HPCL in the other side of the tank farm. The compound wall has been dismantled to make a path for the earthmoving vehicle to enter the site. A pit with suitable dimensions has been made ready for this purpose. A layer of fresh soil has been spread inside this pit. The sludge from various pits has been transferred into the Bioremediation pit. Quantity of sludge has been inspected by both HPCL and OFT officials and confirmed as 120 kilo litres. After the sludge is dumped, it has been evenly levelled inside the pit. The first sample has been collected and given for laboratory analysis to a laboratory approved by HPCL. **The Oil & Grease content is reported to be 12.17% before starting any process.**

A layer of fresh soil is spread on top and the entire contents of the pit have been thoroughly mixed. The first application of bioenzymes and nutrients have been given. From the 2nd day onwards, water spray has been given daily for the next two weeks. Then a tractor has been deployed for tilling thoroughly inside the pit. Then the second application, daily water spray and subsequent applications were carried out. Sufficient amount of nutrients were applied from time to time. In order to supplement the supply of oxygen, plastic pipes were installed at all the octahedral corners of the bioremediation pit. These pipes were perforated all around, so as to increase the effectiveness.



The third, fourth, and fifth application of bio enzymes and nutrients were given at the appropriate intervals. Periodical monitoring and sampling were carried out. Laboratory analysis of the samples in the middle of the process was conducted to record the changes occurred. Subsequently, the sixth application has been given. The percentage of oil & grease has been gradually decreasing, from 12.17% to 3.24, and then to 2.79, and then to 1.73%. Later, after completion of the 7th application, the sludge has been totally re mediated and stripped of the oil & grease content. The heavy metals present at the beginning were non detectable and the concentration of other metals have also been reduced. Vegetation has commenced inside the Bioremediation pit. The plant growth has been increasing by virtue of the sludge converted manure, rich with organic carbon and other soil nutrients. **The final laboratory report confirms the percentage of oil & grease content as less than 1%, as against the 12.17% existed before commencement of this bio remediation process.**



## Operations Diary

7th October 2006..... Inspection of Bio remediation Pit by HPCL and OFT officials  
9th October 2006..... Measuring the Bioremediation pit area and marking boundaries. Starting the excavation of the pit for 120 KI sludge.  
11th October 2006..... Completion of the excavation work. The Bioremediation pit admeasuring 44.5mtrX15mtrX0.07mtrwas made ready.  
18th October 2006..... Transfer of sludge from the three storage pits to the new pit. Measurement of sludge dumped inside.  
3rd November 2006... Spreading the sludge allover the pit and levelling it.  
10th November 2006.. Collection of sludge samples for laboratory analysis supervised by HPCL officials.  
11th November 2006.. Handed over the sample to Netel Lab  
20th November 2006.. Adding clay to the sludge and mixing  
23rd November 2006.. 1st Treatment with SOLPAR and Nutient solution  
23rd to 27th November 2006..... Spraying of water twice daily  
28th November 2006.. 2nd Treatment with SOLPAR and Nutient solution  
28th November to 10th December 2006...Spraying of water twice daily  
13th December 2006.. Tilling the entire pit with tractor  
14th to 20th December 2006..... Spraying of water twice daily  
21st December 2006.. Mixing of sludge pit to bring bottom sludge upwards  
22nd December 2006.. Collection of sludge samples for laboratory analysis supervised by HPCL officials.  
23rd December 2006.. 3rd Treatment with SOLPAR and Nutrient solution  
24th December to 16th January 2007... Spraying water. Installing plastic pipes.  
17th to 23rd January 2007.. Mixing of sludge pit to bring bottom sludge upwards  
14th January 2007.... 4th Treatment with SOLPAR and Nutrient solution  
14th January to 8th February 2007..... Spraying water twice daily  
9th February 2007..... Mixing of sludge pit to bring bottom sludge upwards  
10th Febraury 2007.... Collection of sludge samples for laboratory analysis supervised by HPCL officials.  
11th to 28th Febraury 2007.. Spraying water twice daily  
2nd March 2007..... 5th Treatment with SOLPAR and Nutrient solution  
5th March 2007 to 10th April 2007.... Spraying water twice daily  
15th April 2007... 6th Treatment with SOLPAR and Nutrient solution  
17th April 2007 to 30th June 2007..Spraying water on alternate days and on non raining days  
12th July 2007.. Mixing of sludge pit to bring bottom sludge upwards  
17th July 2007... Collection of sludge samples for laboratory analysis supervised by HPCL officials.  
18th July 2007 .. 7th Treatment with Nutrient solution  
10th November 2007, 21st January 2008.... Inspection by OFT and HPCL officials. The colour, porosity and character of the treated sludge changes akin to normal soil. Traces of vegetation noticed.  
18th February 2008... Growth of vegetation is visible prominently inside the treated sludge pit.  
7th March 2008.. Collection of sludge samples for laboratory analysis supervised by HPCL officials.





## Sludge pit



Sludge as stored in the pit inside the tank farm.



## Sludge pit



Sludge as stored in the pit inside the tank farm.



## Excavation of Bioremediation pit



Completion of the excavation work. The Bioremediation pit admeasuring 44.5mtr(L)X15mtr(B)X0.07mtr(D) was made ready.



## Transferring sludge



Sludge from the stored pits was transferred into the Bioremediation pit. Quantification of sludge was confirmed by both OFT and HPCL officials.



## Levelling of sludge



After the Sludge was dumped into the Bioremeidation pit, levelling has been carried out evenly.





## Tilling sludge soil mixture



Thorough tilling of the Bio remediation pit was carried out so that sludge and soil are completely mixed.



## Sludge ready for the spray



Sludge bed is made ready after tilling for spraying SOLPAR solution





## Side view after the 6th spray



View from the side after completion of the 6th spray





## Wall side view after remediation



Upon completion of the 6th spray, the Bio remediation pit as seen in the wall side view.



## Tank side view after remediation



The Bio remediation is completed after the 7th spray as seen in the tank view.





## Plant growth inside the remediation pit



The sludge has been successfully treated. The oil & grease contents have come down to 1%. The sludge has been converted as rich manure and the creeper growth has commenced inside the pit.



## Close up of the Plant growth



The closeup view of a plant grown inside the Bioremediation pit, after the sludge is converted as carbon rich manure. Laboratory analysis has confirmed the oil & grease percentage is less than 1%.



## Comparison of the Laboratory Analysis data

<i>Parameter</i>	<i>Before Bio remediation</i>	<i>After Bio remediation</i>
<b>Oil &amp; Grease</b>	<b>12.17 mg/gm</b>	<b>0.4 mg/gm</b>
<b>Chromium</b>	<b>33.29 ppm</b>	<b>20.28 ppm</b>
<b>Nickel</b>	<b>46.67 ppm</b>	<b>21.07 ppm</b>
<b>Cadmium</b>	<b>0.242 ppm</b>	<b>Non detectable</b>
<b>Mercury</b>	<b>462.05 ppm</b>	<b>Non detectable</b>

Netel Labs Reports attached.....





**Netel (India) Limited**


## OIL SLUDGE ANALYSIS REPORT

**Client : M/s. Oil Field Tekniks**  
1-1-300/B, 2nd floor,  
Syndicate Bank building,  
Ashok Nagar,  
Hyderabad - 500 020

<b>Date of Sampling :</b>		<b>22/12/2006</b>
<b>Sampling Location :</b>		<b>Oil Sludge Sample at HPCL, Vashi</b>
		<b>Sludge No. 2</b>
<b>Sl. No.</b>	<b>Parameters ,units</b>	
1	Phase	Solid
2	Colour	Black
3	Texture	Silt loam
4	Sand, %	35.9
5	Silt, %	50.5
6	Clay, %	13.6
7	Specific Gravity	0.986
8	Water Content, %	0.785
9	Moisture content, %	0.785
10	pH (1:10 suspension)	6.04
11	Oil & Grease, mg/gm	3.24
12	Chromium (as Cr), ppm	27.52
13	Nickel (as Ni), ppm	29.75
14	Cadmium (as Cd), ppm	0.21
15	Mercury (as Hg), ppm	340.5

**Note : Sample collected by party**

**For Netel (India) Limited**

  
**Swapna Ghatge**  
Govt. Analyst.

**MoEF Recognised Laboratory**

**A Neterwala Group Company**

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Netel (India) Limited

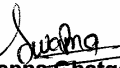
## OIL SLUDGE ANALYSIS REPORT

Client : M/s. Oil Field Tekniks  
1-1-300/B, 2nd floor,  
Syndicate Bank building,  
Ashok Nagar,  
Hyderabad - 500 020

Date of Sampling :		10/2/2007
Sampling Location :		Oil Sludge Sample at HPCL, Vashi
		Sludge No. 3
Sl. No.	Parameters ,units	
1	Phase	Solid
2	Colour	Black
3	Texture	Silt loam
4	Sand, %	36.9
5	Silt,%	53.4
6	Clay,%	9.7
7	Specific Gravity	1.042
8	Water Content ,%	1.278
9	Moisture content ,%	1.278
10	pH (1:10 suspension)	7.3
11	Oil & Grease,mg/gm	2.79
12	Chromium (as Cr),ppm	26.18
13	Nickel (as Ni),ppm	26.55
14	Cadmium (as Cd),ppm	0.2
15	Mercury (as Hg),ppm	310.4

Note : Sample collected by party

For Netel (India) Limited

  
Swapna Ghatge  
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Netel (India) Limited

## SLUDGE ANALYSIS REPORT

Client : M/s. Oil Field Tekniks  
1-1-300/B,2nd floor,  
Syndicate Bank building,  
Ashok Nagar,  
Hydrabad 500 020

Date of Sampling :		10/11/2006
Sampling Location :		Before Bio Remediation Process Sludge no. 1
Sl. No.	Parameters ,units	
1	Phase	Solid
2	Colour	Black
3	Texture	Silt loam
4	Sand, %	30.9
5	Silt,%	52
6	Clay,%	17.1
7	Specific Gravity	0.862
8	Water Content ,%	2.209
9	Moisture content ,%	2.209
10	pH (1:10 suspension)	7.2
11	Oil & Grease,mg/gm	12.17
12	Chromium (as Cr),ppm	33.29
13	Nickel (as Ni),ppm	46.67
14	Cadmium (as Cd),ppm	0.242
15	Mercury (as Hg),ppm	462.5

Note : Sample collected by party

For NETEL INDIA LIMITED

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# OIL SLUDGE ANALYSIS REPORT

**Netel (India) Limited**

Client : M/s. Oil Field Tekniks  
1-1-300/B,2nd floor,  
Syndicate Bank building,  
Ashok Nagar,  
Hydrabad- 500 020

Date of Sampling :		17/07/2007
Sampling Location :		After Bioremediation Process Sludge no. 5
Sl. No.	Parameters ,units	
1	Phase	Solid
2	Colour	Black
3	Texture	Silt loam
4	Sand, %	32.3
5	Silt,%	48.8
6	Clay,%	18.9
7	Specific Gravity	1.104
8	Water Content ,%	2.23
9	Moisture content ,%	2.23
10	pH (1:10 suspension)	7.4
11	Oil & Grease,mg/gm	1.73
12	Chromium (as Cr),ppm	25.27
13	Nickel (as Ni),ppm	31.61
14	Cadmium (as Cd),ppm	ND
15	Mercury (as Hg),ppm	315.4

Note : Sample collected by party

ND : Not Detected

For Netel (India) Limited

Swapna Ghatge  
Govt. Analyst



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Netel (India) Limited

## SLUDGE ANALYSIS REPORT

Client : M/s. Oil Field Tekniks  
1-1-300/B,2nd floor,  
Syndicate Bank building,  
Ashok Nagar,  
Hydrabad 500 020

Date of Sampling :		7/3/2008
Sampling Location :HPCL Vashi		After Bioremediation Process Sludge no. 6
Sl. No.	Parameters ,units	
1	Phase	Solid
2	Colour	Yellowish Brown
3	Texture	Silt Clay
4	Sand, %	10
5	Silt,%	42
6	Clay,%	48
7	Specific Gravity	1.29
8	Water Content ,%	2.03
9	Moisture content ,%	2.03
10	pH (1:10 suspension)	6.8
11	Oil & Grease,mg/gm	0.4
12	Chromium (as Cr),ppm	20.28
13	Nickel (as Ni),ppm	21.07
14	Cadmium (as Cd),ppm	ND
15	Mercury (as Hg),ppm	ND

Note : Sample collected by party

ND : Not Detectable

For Netel (India) Limited

Swati Damri

Analyst.

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## **Comparison of Sludge**



Before Bio remediation



After Bio remediation