

REPORT ON BIO REMEDIATION OF SLUDGE

HINDUSTAN PETROLEUM CORPORATION LTD.,
KANDLA TERMINAL,
GANDHIDHAM(KACHCHH), INDIA



OIL FIELD TEKNIKS

REPORT ON BIO REMEDIATION OF SLUDGE

PO Number 6000109-OP-11583

Industry

**HINDUSTAN PETROLEUM CORPORATION LTD.,
Kandla Terminal, Village Kharirohar,
P.O. Box No.43, Gandhidham(Kachchh), 370201**

Consultants

OIL FIELD TEKNIKS



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ACKNOWLEDGEMENTS

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Project team
Oil Field Teknics



Objective

Bio-remediation of 50 Kilolitres of sludge, retrieved from tank bottom. 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 with Oil & Grease content 1%.

Date of initiation : 28th March 2007

Date of completion : 9th October 2009

Laboratory Analysis

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



Summary Operations Diary

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Summary

Hindustan Petroleum Corporation Ltd., Kandla Terminal, Gandhidham has awarded the contract of Bio remediation of sludge to Oil Field Teknics, Hyderabad. The subject sludge has been stored inside the terminal.

A site for carrying out Bioremediation has been identified by HPCL inside the terminal. Oil Field Teknics has accepted and recommended the dimensions of Bioremediation pit. The sludge had to be transferred to the Bioremediation pit on the other side of railway track. Subsequently, a pit with requisite dimensions has been dug for the purpose. A layer of the fresh clay was spread inside this pit. Then the sludge was transferred into the Bioremediation pit by HPCL. OFT official has supervised the transfer of sludge. The quantity of sludge transferred, has been confirmed as 80 Kilo litres by HPCL officials. Before starting any other activity, a sample of the sludge has been collected in the presence of HPCL and OFT officials. This was the first sample, and was given for analysis to a laboratory approved by Ministry of Environment & Forests, Government of India. The Oil & Grease content in the sludge was reported to be 34.7% before starting any process.

The next step was to mix the sludge with clay. For this purpose, OFT has mobilized a concrete mixing equipment for one week. After the mixing is done with this equipment, the mixture was dumped inside the pit. Simultaneously, it has been evenly leveled inside the pit by manual means. After completing the same, the first treatment of SOLPAR and REM B was given. For this purpose, HPCL has provided empty barrels for mixing the solution. From the second day onwards, water was sprayed in the pit daily, until the next treatment. After three weeks, the contents of the pit were thoroughly mixed by manual means. Then the 2nd treatment of SOLPAR and REM B was given. Daily water spray followed for the next three weeks. Sufficient amount of nutrients were mixed with water, and applied from time to time.

The third treatment of SOLPAR and REM B was given followed by water spray. Also at this stage, tilling inside the pit was carried out thoroughly by manual means. Sludge from the bottom has been brought upwards, and the water spray was continued daily. At this stage, the laboratory has reported that the Oil & Grease content has come down to 20.6%.

The Fourth and fifth treatments were also given at appropriate intervals. Again after completion of the 5th treatment, the third sample of the sludge under treatment was collected in the presence of HPCL officials.



Then, the Sixth treatment of SOLPAR and REM B was given. Water spraying was continued all the while in between all the activities. But, it was noticed that some lumps of partly degraded sludge were scattered in the pit. Hence, a poclaine was deployed for removing the bottom contents of the pit to the top and vice versa. This job was thoroughly completed by poclaine.

In order to supplement the supply of oxygen, OFT officials have installed plastic pipes at all the octahedral corners of the bioremediation pit. These pipes were perforated all around, so as to increase the effectiveness in providing oxygen throughout the bioremediation pit. Laboratory analysis of the samples in the middle of the process was conducted to record the changes occurred. At this stage, the laboratory has reported that the oil & grease content has come down to 9.1%.

Later, the 7th treatment of SOLPAR and Nutrients REM R, and REM B was given. Periodical monitoring of the activities was carried out. In order to ensure uniform biological activity, a tractor was again deployed for thorough tilling of pit before giving the 8th treatment. Subsequently, the 8th, 9th and 10th treatments have been given and the water spray was continued on appropriate intervals.

The percentage of Oil & Grease has gradually decreased from 34.7% to 20.6% and then to 9.1%. By this time, sludge in the bioremediation pit has been degraded to a major extent. But small patches were noticed which needed to be broken and treated. Hence, thorough mixing of the entire pit was carried out manually for a few days. Later, the 11th treatment of SOLPAR and Nutrients REM R, REM B was given. Water spray was carried out daily. By the end of this period, the sludge was totally remediated and stripped off the oil & grease content. The heavy metals present at the beginning were non detectable and concentration of other metals also have been reduced.

Then, the last sample was collected in the presence of HPCL officials, and was given for laboratory analysis. Even though the process was completed, an additional dosage of SOLPAR and Nutrients REM B was given to enrich the contents of the pit. This was the 12th treatment. The laboratory has reported that the Oil & Grease content in the sludge was reduced to 1%. OFT has advised to spray water in the pit once in a while to maintain moisture in the biomass.

The final laboratory report confirms the percentage of oil & grease content is 1% against the 34.7% existed before commencement of the Oil Field Teknics Bioremediation process.



Operations Diary

27 th March 2007	Inspection of Bioremediation Pit by HPCL and OFT officials.
28 th March 2007	Measurement of the pit area and marking boundaries.
16 th April 2007	Started excavation of the pit for 80 KI sludge.
17 th April 2007	Excavation work continued.
18 th April 2007	Completion of excavation work.
19 th April 2007	
to	
21 st May 2007	Transfer of sludge to the pit
22 nd May 2007	
to	
28 th May 2007	Mixing sludge and clay with Mixing equipment
29 th May 2007	Spreading the sludge inside the pit and levelling Collection of Sludge sample for Laboratory analysis.
02 nd June 2007	
to	
07 th June 2007	Transfer of sludge to the pit continued.
08 th June 2007	
to	
09 th June 2007	Spreading the sludge inside the pit and levelling .
20 th July 2007	Site inspection by OFT engineer. Noticed extra sludge dumped on the pit.
23 rd July 2007	Discussed about the difference in quantification with HPCL officials on the extra quantity of sludge. As per their request, accepted the extra sludge also for the bioremediation work.
24 th July 2007	Adding clay to sludge in the pit.
25 th July 2007	Adding clay to sludge is continued.
26 th July 2007	Thorough mixing of sludge with clay.
27 th July 2007	1st Treatment: Preparation of SOLPAR solution with 5 Litres of SOLPAR mixed with 495 Litres of water. Sprayed solution on the entire Pit.



Operations Diary

28 th July 2007	Preparation of Nutrients solution with 5 Kgs. of Rem-B mixed with 500 Litres of water. Sprayed solution on the entire Pit.
29 th July 2007 to 05 th September 2007	Water spray in pit.
06 th September 2007	Inspection of the site by OFT engineer.
07 th September 2007	Adding clay to sludge in the pit.
08 th September 2007	Thorough mixing of sludge with clay.
09 th September 2007	2nd Treatment: Preparation of SOLPAR solution with 5 Litres of SOLPAR mixed with 495 Litres of water. Sprayed solution on the entire pit.
10 th September 2007	Preparation of Nutrients solution with 5Kgs. of Rem-B mixed with 500 Litres of water. Sprayed solution on the entire pit.
11 th September 2007 to 11 th November 2007	Water spray on pit.
12 th November 2007	Inspection of the site by OFT engineer.
13 th November 2007 to 15 th November 2007	Tilling entire pit and bring bottom layer to top.
16 th November 2007	Tilling entire pit and bringing bottom layer to top
17 th November 2007 to 03 th March 2008	Water spray on pit.
04 th March 2008	Inspection of the site by OFT engineer.
05 th March 2008	3rd Treatment: Preparation of SOLPAR solution with 5 Litres of SOLPAR mixed with 495 Litres of water. Sprayed solution on the entire pit.
6 th March 2008	Preparation of Nutrients solution with 5Kgs. of Rem-B mixed with 500 Litres of water. Sprayed solution on the entire pit.
7 th March 2008 to 4 th June 2008	Water spray on pit.



Operations Diary

5 th June 2008	Inspection of the site by OFT engineer. Collection of Sludge sample for Laboratory analysis.
6 th June 2008	4th Treatment: Preparation of SOLPAR solution with 5 Litres of SOLPAR mixed with 495 Litres of water. Sprayed solution on the entire pit.
8 th June 2008	Preparation of Nutrients solution with 5Kgs. of Rem-B mixed with 500 Litres of water. Sprayed solution on the entire pit.
10 th June 2008 to 13 th August 2008	Water spray on pit
14 th August 2008	Inspection of the site by OFT engineer.
16 th August 2008 to 18 th August 2008	Tilling entire pit and bring bottom layer to top
19 th August 2008 to 5 th October 2008	Water spray on pit.
6 th October 2008	Inspection of the site by OFT engineer.
7 th October 2008	5th Treatment: Preparation of SOLPAR solution with 5 Litres of SOLPAR mixed with 495 Litres of water. Sprayed solution on the entire pit.
09 th October 2008	Preparation of Nutrients solution with 5Kgs. of Rem-B mixed with 500 Litres of water. Sprayed solution on the entire pit.
10 th October 2008 to 25 th November 2008	Water spray on pit.
26 th November 2008	Inspection of the site by OFT engineer. Collection of Sludge sample for Laboratory analysis.
27 th November 2008 to 30 th November 2008	Procurement of Clay: Searched and sourced for clay in the nearby villages of Kandla.



Operations Diary

1 st December 2008	Adding clay and thorough mixing of sludge with clay.
2 nd December 2008	6th Treatment: Preparation of Nutrients solution with 3Kgs. of Rem-B mixed with 200 Litres of water. Sprayed solution on the entire pit.
3 rd December 2008	Preparation of SOLPAR solution with 3 Litres of SOLPAR mixed with 197 Litres of water. Sprayed solution on the entire pit.
4 th December 2008 to 10 th December 2008	Water spray on pit.
11 th December 2008	Sent the sludge sample to the laboratory.
to 31 st December 2008	Water spray on pit.
1 st January 2009	Inspection of the site by OFT engineer
3 rd January 2009	Tilling entire pit with JCB.
4 th January 2009	Insertion of Pipes Measurement of the pit. Finding locations for introduction of PVC pipes inside the sludge pit. Marking spots and insertion of Pvc pipes
5 th January 2009	7th Treatment: Preparation of Nutrients solution with 3Kgs. of Rem-R mixed with 200 Litres of water. Sprayed solution on the entire pit.
6 th January 2009	Preparation of SOLPAR solution with 3 Litres of SOLPAR mixed with 197 Litres of water. Sprayed solution on the entire pit.
7 th January 2009	Preparation of Nutrients solution with 3Kgs. of Rem-B mixed with 200 Litres of water. Sprayed solution on the entire pit.
8 th January 2009 to 3 rd February 2009	Water Spray on pit.
04 th February 2009	inspection by OFT engineer. 8th Treatment: Preparation of Nutrients solution with 3Kgs. of Rem-B mixed with 500 Litres of water. Sprayed solution on the entire pit.



Operations Diary

5 th February 2009	Preparation of SOLPAR solution with 3 Litres of SOLPAR mixed with 497 Litres of water. Sprayed solution on the entire pit.
8 th February 2009 to 12 th April 2009 13 th April 2009	Water spray on pit. Inspection by OFT engineer 9th Treatment: Preparation of SOLPAR solution with 3 Litres of SOLPAR mixed with 497 Litres of water. Sprayed solution
15 th April 2009	Preparation of Nutrients solution with 3Kgs. of Rem-B mixed with 500 Litres of water. Sprayed solution on the entire pit.
16 th April 2009 to 15 th June 2009 16 th June 2009 20 th June 2009 the 22 nd June 2009 23 rd June 2009 24 th June 2009	Water Spray on pit. Inspection of the site by OFT engineer. Plastic Pipes removed from pit. Mixing inside pit was carried out by manual means. Tilling entire pit with Tractor. Plastic Pipes reinserted in the pit 10th Treatment: Preparation of SOLPAR solution with 3Litres of SOLPAR mixed with 197 Litres of water.Sprayed solution on the entire pit.
25 th June 2009 26 th June 2009	Water spray on pit. Preparation of Nutrients solution with 3Kgs. of Rem-B mixed with 500 Litres of water. Sprayed solution on the entire pit.
27 th June 2009 to 16 th July 2009 17 th July 2009	Water Spray on pit. 11th Treatment: Preparation of Nutrients solution with 2.5Kgs. of Rem-R mixed with 200 Litres of water. Sprayed solution on the entire pit.



Operations Diary

20 th July 2009	Preparation of Nutrients solution with 5Kgs. of Rem-B mixed with 500 Litres of water.
21 st July 2009	Preparation of SOLPAR solution with 5 Litres of SOLPAR mixed with 495 Litres of water. Sprayed solution on the entire pit by a foot Sprayer.
22 nd July 2009	Water spray on pit.
23 rd July 2009	
to	
4 th October 2009	Water Spray on pit.
5 th October 2009	12th Treatment: Preparation of SOLPAR solution with 5 Litres of SOLPAR mixed with 495 Litres of water. Sprayed solution on the entire pit.
6 th October 2009	Preparation of Nutrients solution with 5Kgs. of Rem-B mixed with 500 Litres of water. Sprayed solution on the entire pit. Collection of Sludge sample for Laboratory analysis.
7 th October 2009	Water spray on pit.
9 th October 2009	Sent the sludge sample to the laboratory for analysis.
9 th October 2009	Suggested to continue the water spray.



Comparison of the Laboratory Analysis data

<i>Parameter</i>	<i>Before Bio remediation</i>	<i>After Bio remediation</i>
Oil & Grease	34.7 %	1%
Chromium	2.3 ppm	1.82 ppm
Nickel	1.3 ppm	Nil
Cadmium	1.24 ppm	Below detectable
Mercury	Nil	Nil



Laboratory Analysis Reports

attached.....

Name of the Industry	M/S. Oil Field Tekniks	Date of Sampling	29 th May 07
Address	1-1-300/B, 2 nd Floor,	Date of Reporting	19 th June 07
	Syndicate Bank Building, Ashok Nagar, Hyderabad -500020	Sample ID	Gandhidham Sludge
REF No:	SL/EM/06-478		

SLUDGE SAMPLE REPORT

Location	Results(%)
Phase	Solid
Colour	25 Hz
Sand (%)	12%
Sulphate (SO ₄)	0.25
Silt (%)	8%
Density (gm/ml)	2.3 gm/ml
Water content	12.2%
Moisture content (%)	18%
pH (1 :10)	6.9
Oil & Grease (mg/L)	34.7%
Chromium (mg/L)	2.3 ppm
Nickel	1.3%
Cadmium	1.24 ppm
Mercury	Nil

MoEF No : S.O.774(E) dated 7th June 2005

Sample collected by : Client

Checked by: *Rambabu*

Authorised by : *Sh. Durga Shovani*

Recognised by Ministry of Environment & Forests, (MoEF) GOI, New Delhi
Recognised by Drugs Control Administration, Govt. of Andhra Pradesh

Name of the Industry	Oil Field Tekniks	Date of Sampling	05 th June 08
Address	1-1-300/B, 2 nd Floor, Syndicate Bank Building, Ashok Nagar, Hyderabad - 500020	Date of Reporting	28 th June 08
REF No:	SL/EHS/F05001/08		

Gandhidham Sludge No 2- ANALYSIS REPORT

Parameter	Result
pH	7.5
Colour	5hazen units
Texture	Greasy & Oily
Sand %	10
Silt %	6.8
Specific Gravity	1.9641
Loss on Drying%	7.32
Oil & Grease%	20.6
Chromium PPM	0.235
Nickel PPM	0.3107
Cadmium PPM	BDL
Mercury PPM	ND
Phase	Solid
Sample analysis done as per IS 3025	

Sample Collected by : Client

Checked by : *Rembabu*
28/06/08

Authorised by : *Bivaslam*

Recognised by Drugs Control Administration, Govt. of India
Recognised by Ministry of Environment & Forests, (MoEF) GOI, New Delhi
Approved Laboratory by Directorate General of Mines Safety, Ministry of Labour & Employment



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Name of the Industry	Oil Field Tekniks	Date of Sampling	11 th Dec 08
Address	1-1-300/B, 2 nd Floor, Syndicate Bank Building, Ashok Nagar, Hyderabad - 500020	Date of Reporting	20 th Dec 08
REF No:	SL/EHS/L11003/08		

Gandhidham Sludge No 3- ANALYSIS REPORT

Parameter	Result
pH	7.8
Colour	10hazen units
Texture	Greasy & Oily
Sand %	8.6
Silt %	5.9
Specific Gravity	1.6065
Moiuster Content %	4.69
Oil & Grease%	9.1
Chromium Ppm	50.06
Nickel Ppm	ND
Cadmium Ppm	ND
Mercury Ppm	ND
Phase	Semi Solid
Water Content %	20.96
Sample analysis done as per IS 3025	

Sample Collected by : Client

Checked by : *Pombaba*
20/12/08

Authorised by : *Divastava*

Recognised by Drugs Control Administration, Govt. of India
Recognised by Ministry of Environment & Forests, (MoEF) GOI, New Delhi
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TEST REPORT

Name of the Industry **M/s. OIL FIELD TEKNIKS,** Date of Sampling **09th October 09**
 Address **Hyderabad. Andhra Pradesh.** Date of Reporting **21st October 09**
 REF No: **SL/EHS/J 09001/09**

SLUDGE SAMPLE - ANALYSIS REPORT

S.No.	Parameters	Results
1.	pH	7.62
2.	Colour, (Hazen Units)	20
3.	Moisture Content (%)	9.29
4.	Water Content (%)	2.16
5.	Oil & Grease (%)	1.0
6.	Texture	Clay loam
7.	Specific Gravity (gr/ml)	1.29
8.	Sand%	14.88
9.	Clay%	42.06
10.	Silt%	13.29
11.	Chromium as Cr (ppm)	1.82
12.	Nickel (ppm)	Nil
13.	Cadmium (ppm)	BDL
14.	Mercury as Hg(ppm)	Nil
15.	phase	Solid

Sample Collected by : Client

Remarks : Sample Analysed as per customer's request.

BDL : Below Detective Limits

Checked by : *Jhansi* 21/10/09
 Authorised by: *Rambabu* 21/10/09

REPORT ON BIO REMEDIATION OF SLUDGE

by



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