Failure and Rehabilitation of Oil Pipeline Leaks under water

Shiva Sunder and C. Vipulanandan, Ph.D., P.E.
Centre for Innovative Grouting Materials and Technology (CIGMAT)
Department of Civil and Environmental Engineering
University of Houston, Houston, TX, 77204-4003
Tel: (713)743-4291 Email Address: ssunder@mail.uh.edu

Abstract: Offshore structures mainly are composed of industries and pipelines that are constructed in marine environment for the production and transport of electricity, oil or gas. Hence high levels of maintenance are required to prevent the failure of their working. The following study illustrates and compares the failures occurred in the oil-pipelines constructed under waters. It also gives a brief overview of the corrective action and rehabilitation measures taken to resolve the pipeline leaks.

1. Introduction

Offshore structures mainly are composed constructed for the purpose of wave and wind action prediction, country's naval component and oil platforms or oil pipelines for transporting oil. Accidents often occur due to the negligence of the maintenance personnel, defective design to bare the pressure and loads and head on collision of the structures with vessels. It is to be noted that over 10 pipe leaks have occurred under water over a period of past 100 years. The following study is a brief investigation of a few accidents caused in pipelines constructed below water. This study also aims at comparing the past accidents with the ongoing Deep Water Horizon pipe line leak.

2. Objective

The objective of the study was to investigate and document the reasons for the failure of oil spills and their impact on the environment and wildlife giving importance to the ongoing Deep Water Horizon oil spill.

3. Case Studies

The following are the basic parameters considered for the documentation. They are, location, date of occurrence, estimated loss due to leak, content, cause, leak rate, affected wildlife and consequences and rehabilitation. Three case studies were analyzed as a part of this study. They are a) Red Butte Creek oil spill, b) Montara Oil Spill and c) Deep Water Horizon Oil Spill.

Table 1: summary of Recent Oil- Pipeline Leaks in Water

Case Studies	Red Butte Creek Oil Spill (a)	Montara Oil Spill (b)	BP Deep Water Horizon Oil Spill (c)
Location	Red Butte Creek, Salt Lake City	Montara oil field, Timour Sea, northern coast of Western Australia.	Gulf Of Mexico
Date of Occurrence	10:00 pm, 11 june 2010-12 June 2010	August 21, 2009 – November 3, 2009 (74 days)	Discovered – 24th April, 2010
Estimated Loss	30000 Gallons	2300 square miles. 1.2 million gallons to over 9 million gallons (estimate)	140-148 million gallons as of mid July 2010
Content	Crude Oil	Crude Oil	Crude oil with asphalt like substances

Cause	Preliminary observations indicate the cause of the leak to be an electrical arc that created a hole the size of a quarter in the top of the pipe	Not revealed, under inquiry	Not given by the owner. A fail Safe Device fitted at the base of the well has a hydraulic leak and failed battery causing failure.
Leak Rate	50-60 gallons per minute into the creek	2000 barrels/day- one estimation; 400 barrels/day – another estimation.	5000 barrels per day – april 29th. 19000 barrels per day – 27th may. 30000 barrels – 10th june. 35000-60000 barrels per day- 15th june.
Affected wildlife and Consequences	Ducks and geese	toxic effect on marine invertebrates, coral, algae and birds. Risk for whales and flatback turtles	Oxygen depletion, birds, sea turtles dolphins and other mammals.
Rehabilitation	Wildlife moved to Hogle zoo. Leak capped by the fire teams. Large backhoe was used to dig several containment ponds. Chevron vacuum truck was used to pump oil from the pond and take it to the local chevron refinery. Aggressively recover oil throughout the affected areas. Divide the affected areas into 18 sections and survey each for contamination and prioritization for clean-up efforts. Develop remediation plans, based on survey results, with regulatory authorities and immediately implement the plan. Continue to asses and clean up Red Butte Creek bed and shore.	Spraying chemical dispersants, drilling rig to plug the leak. pumping mud into the well, and wellbore cemented, capping the blowout	Underwater vehicles to close the blowout preventer valves. Constructing relief wells.

4. Discussion

Of the three oil-pipeline leaks discussed in this study, it is to be noted that the BP oil spill has the maximum leak rate and expanse. It is also the largest in duration compared to the other two oil spills. It is to be noted that, the effect of Red Butte Oil Creek is very less compared to the BP oil spill and Montara Oil Spill because the spill took place over the river and not sea.

5. Conclusions

Studies show that the leaks cause severe damage to the aquatic and neighboring wildlife. The oil slick which covers the surface of the ocean depletes oxygen in water which causes extremely difficulty to the aquatic habitat. In each of the case studies, different measures have been carried out to approach the oil leak.

6. Acknowledgement

The study was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT).

7. References

1. Deep water Horizon Oil Spill - http://en.wikipedia.org/wiki/Gulf_Coast_oil_spill.
2. Montara Oil Spill- http://en.wikipedia.org/wiki/Montara_oil_spill.
3. http://www.fogsl.org/advocacy/current-issues/203-red-butte-creek-oil-spill
4. Red Butte Creek Oil Spill- http://en.wikipedia.org/wiki/Red_Butte_Creek_oil_spill