Oil as a pollutant

Crude oil is a complex mixture of different substances which are majorly hydrocarbons. It is popularly nicknamed ‘Black Gold’ as a result of economic benefits derivable from it. However, it is often a major source of pollution to the environment.
Oil as a Pollutant

• When crude oil is spilled in large concentration in an environment, it poses a lot of danger to all forms of lives and the entire ecosystem. Generally, the polluting nature of crude oil in the environment is enhanced by properties such as:
  • Volatility,
  • Viscosity,
  • Asphaltene content,
  • Toxic/Smothering ability and
  • Specific gravity/API
Regulatory Requirements

- An oil spills contingency plan and response procedures clearly documented by operators.

- Activation of the contingency plan to ascertain preparedness to respond to emergencies.

- Statutory reporting of all spills to DPR. The statutory reporting periods are: form A - within 24 hours; form B - within two weeks; and form C - within four (4) weeks.

- Statutory reporting of oil spill incidents to FEPA.

- Mandatory, for operator, to stock a minimum quantity of functional oil spill response equipment and materials.

- Restoration of polluted sites to as close as possible to pre-spill conditions. Residual oil < 2%w/w
The National Oil Spill Contingency Plan

The National Oil Spill Contingency Plan establishes Three Tier level of Spill Response and Contingency Plans

**Level 1:** Company Spill response Plan for small spill less than 20bbl

**Level 2:** Industry Cooperative Response Plan for medium spill to include CNA response activation

**Level 3:** National Plan response Plan to include OSRL
Causes of Oil-Spills

- Equipment failure
- Human error
- Drilling operations
- Emergency operations
- Intentional discharge/sabotage
Prevention of Equipment Failure

Equipment failure can be checked by the following practices.

- Pipeline replacement programs
- Pipeline monitoring
- Cathodic protection and monitoring for pipelines
Human Errors

These are basically caused by failure of operators to operate system using standard operating procedures (SOP) or supply wrong attitude.

This result in minor spills.
To minimize human errors the following should be considered:

- The use of automated system such as Computer Assisted Operating System (CAOS) which works on SCADA (Supervisory Control And Data Acquisition)
- Use of standard operating procedures
- Training and awareness training.
Intentional Discharge

Intentional discharge occur when it is important to discharge content for the safety of the system.

It can be minimized through:

- Regulatory approach
- Equipment such as oil bags
- Treatment facilities on FPO
Sabotage

The objectives of most sabotage has been

1. Theft of equipment
2. Theft of product
3. Compensation claims
4. Political reasons
Contd.

Preventing sabotage:

• Physical surveillance by hired community members
• Maintaining of the pipeline right of ways
• Early warning/alarm systems and remote sensing
• Aggressive community development programs
Behavior, Impact and Consequences of Oil-spill

It is of utmost importance to understand the behavior of crude oil when it spills into the environment (air, land and water). This will lead the way to understanding the impacts on living and non-living components of the environment and also immediate cum associated consequences.
Behavior of oil during oil-spill depends on oil related factors and environmental factors

<table>
<thead>
<tr>
<th>Oil related factors</th>
<th>Environmental factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatility</td>
<td>Nature of the environment (air, land and water)</td>
</tr>
<tr>
<td>Specific gravity/API</td>
<td>Various climatic and environmental factors: temperature,</td>
</tr>
<tr>
<td>Type/ Nature of the crude</td>
<td>wind speed, wave movement, porosity, soil structure and</td>
</tr>
<tr>
<td>Viscosity</td>
<td>texture, soil profile, flora and fauna present in the</td>
</tr>
<tr>
<td></td>
<td>environment etc.</td>
</tr>
</tbody>
</table>
Weathering of spilled crude oil on land and in water

Weathering of spilled oil undergo approximately the same sets of processes both on land and in water. These processes include the following: Evaporation, Dispersion, Emulsification, Dissolution, Oxidation and Sedimentation.

The end products are basically weathered crude oil and tarballs

Weathered crude or "mousse" is crude petroleum that has lost much of its more volatile components and has mixed with sea water.

Tarballs are hard and crusty on the outside and soft and gooey on the inside. Turbulence in the water or beach activity from people or animals may break open tarballs, exposing their softer, more fluid centers.
Weathered Crude oil
Weathering processes of crude oil

Hydrocarbon Liquid (Spills and Leaks)

Discharge
- Hydrocarbons spill/leak

Evaporation
- Light Hydrocarbons Evaporate Readily

Dispersion and Dilution
- Seabirds and mammals may become contaminated and bio-uptake
- Hydrocarbons spreads and drifts

Emulsification
- Physical Mixing of hydrocarbons forms oil/water emulsions

Natural Dispersion
- Hydrocarbon/oils may impact on shoreline contaminating coastal eco-systems
- Bio-uptake of some hydrocarbons and metals by fish

Sea Level
- Some lighter hydrocarbons dissolve
- Dissolved trace metals form sulphide compounds and settle on seabed

3-D Currents
- Some dispersion of oil droplets thorough water column

Seabed
- Some Biodegradation of hydrocarbons by Micro-organisms in water
- Some oil sticks to suspended sediments and settles on seabed
- Bio-uptake of some Hydrocarbons metals in seabed communities
Key consideration of Oil spill

They include:

- Toxicity
- Biodegradability/Persistence
- Bioaccumulation and tainting
- Scale of effect, duration and type
- Social consideration
HEALTH AND SAFETY CONSIDERATIONS
HEALTH HAZARD OF SPILLS

INHALATION
➢ Corrosive/Severe Irritation
➢ Irritation
➢ No Effect/Slight Effect

SKIN
➢ Corrosive/Severe Irritation
➢ Irritation
➢ No Effect/Slight Effect

EYES
➢ Corrosive/Severe Irritation
➢ Irritation
➢ No Effect/Slight Effect

INGESTION/SWALLOWING
<table>
<thead>
<tr>
<th>Health Hazard Rating</th>
<th>Inhalation</th>
<th>Skin</th>
<th>Eyes</th>
<th>Ingestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosive</td>
<td><em>DO NOT DELAY</em></td>
<td>Remove to air</td>
<td>Rinse with water</td>
<td>See Doctor</td>
</tr>
<tr>
<td></td>
<td><em>DO NOT DELAY</em></td>
<td>See Doctor</td>
<td>Rinse with water</td>
<td>See Doctor</td>
</tr>
<tr>
<td>Severe Irritation</td>
<td><em>DO NOT DELAY</em></td>
<td>Remove to air</td>
<td>Rinse with water</td>
<td>See Doctor</td>
</tr>
<tr>
<td>Irritation</td>
<td>Remove to air</td>
<td>Rinse with water</td>
<td>Water</td>
<td>See Doctor</td>
</tr>
<tr>
<td>No effect</td>
<td>No</td>
<td>Specific Measure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **FIRST AID**
- **Inhalation:** DO NOT DELAY Remove to air See Doctor
- **Skin:** Rinse with water See Doctor
- **Eyes:** Rinse with water See Doctor
- **Ingestion:** See Doctor
The weather

Cold
- exposure, frostbite, windchill, hypothermia

Wet
- discomfort/reduce morale

Heat
- heatstroke, dehydration

Sun
- sunburn, sunstroke
Personal Protective Equipment

Personal protective equipment (PPE) refers to protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury.

The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective to reduce these risks to acceptable levels.
PERSONAL PROTECTION

The type of PPE required will be determined by:

- Physical form of the substance
- Potential health effect
- Quantity handled
- Method of usage

This must take into consideration

- Normal usage
- Spill control and Clean-up
**FIRST AID**

**First Aid** is the emergency treatment given to a casualty while awaiting the arrival of comprehensive medical care or treatment of minor injuries that do not warrant medical attention or would otherwise receive no treatment.

The aim of first aid is:

- To promote quick recovery.
- To prevent the situation from deteriorating.
- To save or preserve life.
ENVIRONMENTAL HAZARDS

Considerations are:

- Toxicity
- Biodegrability/Persistence
- Bioaccumulation and tainting
Goggle
Face Shield
Hard Hat
Reinforced sole footwear
Neoprene
Coveralls
Oil Spill Risk Assessment

- The oil
- The working environment
- The weather
- Clean up equipment
- Clean up chemicals
Environmental condition

• Weather
  - wind, sea state & temperature
• Season
  - amenity use, breeding & migratory cycles
• Tides
  - directional flows in estuaries
  - stranding height on shore
  - springing/neap cycle
Environmental Pollution:

The release of substances or energy into environment in such quantity as to endanger human health and resources
Effect of weathered crude oil when in contact with the skin
A bird covered with spilled oil
Oil Spill Management Process

- Prevention
- Control
- Containment
- Recovery
- Clean Up
- Polishing
- Remediation
- Reclamation
- Restoration
OIL SPILL PREVENTION

• Proper Materials handling procedures
• Appropriate Storage
• Use of Standard Operating Procedures
• Communication/Dissemination
• Use of MSDS
OIL SPILL CONTROL PROCESS

- Isolate / Stop Source
- Containment
- Recovery
- Storage / Transportation
- Clean up (Mechanical)
- Mop-up (Physical)
- Disposal
- Rehabilitation
CONTAINMENT/RECOVERY EQUIPMENT

- Booms (Pocket, River & Ocean Booms)
- Absorbents (Rolls, Pads, Pillows)
- Skimmers
- Vacuum Trucks
- Pumps
- Tanks & Barges
- Dispersants
ENVIRONMENTAL PRECAUTIONS

The principles are:

- Eliminate Contamination
- Prevent Contamination
- Minimize Contamination
- Minimize Impact
Emergency Response Objective
Emergency preparedness and response

- Periodically test procedures
- Detailed planning
- Practical on site simulations
- Desk top based
- Simulation captured on video and used as learning tool
- Assessment of procedures and individuals response
Emergency preparedness and response

After an accident or emergency situation

Regular review and revision

Review procedures and revise where appropriate
Emergency preparedness and response

- Emergency organisation and responsibilities
- List of key personnel
- Training plans
- Information on hazardous materials etc
- Action to be taken for different types of emergencies
- Details of emergency services
- Internal/external communication plans
CONTINGENCY PLAN

A document setting out an organised, planned and co-ordinated course of actions to be followed in case of an emergency such as oil spill, fire outbreak, etc.

* Call out procedure
* Decision Guide to oil spill response
BENEFITS OF CONTINGENCY PLAN

Reduction in:

- Response activities / time
- Damage claims
- Ecological damage
- Criticism from media, public & government
Contingency Plan

A document setting out an organized, planned and co-ordinated course of actions to be followed in case of an emergency such as oil spill, fire outbreak, etc.

* Call out procedure

* Decision Guide to oil spill response
INTRODUCTION TO OIL SPILL RESPONSE EQUIPMENT
Oil spill response equipment

- River/Harbor booms
- Skimmers
- Sorbents
- Chemical/Biological agents
- Vacuums
- Shovels, wheel barrows and other road equipment
Oil Spill Response Equipment

Equipment used includes:

1. Booms: large floating barriers that round up oil and lift the oil off the water
Response Equipment

- Skimmers: skim the oil
Response Equipment

• Sorbents: large absorbents that absorb oil
Response Equipment

- Chemical and biological agents: helps to break down the oil
Response Equipment

- Vacuums: remove oil from beaches and water surface
Main Skimmer Types

- Weir
- Oleophilic
- Vacuum
- Mechanical
Pump Types

• Positive displacement
  - Archimedian screw
  - Mono pump
  - Piston
  - Peristaltic
  - Diaphragm
  - Gear/lobe

• Centrifugal
Sorbents

- Synthetic
- Natural
- Rag
Methods of Oil Spill Response
Mechanical Method

- Mechanical Methods involves use of mechanized equipment's for recovery and containment. The include: Vacuum and Centrifuge, Skimming.

- Vacuum and centrifuge: oil can be sucked up along with the water, and then a centrifuge can be used to separate the oil from the water - allowing a tanker to be filled with near pure oil. Usually, the water is returned to the sea, making the process more efficient, but allowing small amounts of oil to go back as well.
Physical Method

➢ Solidifying: Solidifiers are composed of dry hydrophobic polymers that both adsorb and absorb. They clean up oil spills by changing the physical state of spilled oil from liquid to a semi-solid or a rubber-like material that floats on water. Solidifiers are insoluble in water, therefore the removal of the solidified oil is easy and the oil will not leach out.

➢ Example includes, C.I.Agent, Marine and Sheen Booms
Physical Method

Advantage of Solidifying
• non-toxic to aquatic and wild life

Disadvantage of Solidifying
• The reaction time for solidification of oil could be slow
Chemical Method

• Chemicals (Dispersants) can be used to dissipate oil slicks. A dispersant is either a non-surface active polymer or a surface-active substance added to a suspension, usually a colloid, to improve the separation of particles and to prevent settling or clumping.

• They may rapidly disperse large amounts of certain oil types from the sea surface by transferring it into the water column. They will cause the oil slick to break up and form water-soluble micelles that are rapidly diluted.
Advantages of Chemical Method

- Quick response
- Removes risk of:
  - shoreline contamination
  - potential fire hazard
- Reduces contamination of birds etc...
- Inhibits formation of `chocolate mouse`
- Cheaper than mechanical
- Improves biodegradation
Clean –up Chemicals

- Product information sheets
- Hazards data sheet
- Personal protective clothing
- Training/ supervision
- De- contamination
Disadvantage of use

• Oil is not removed, re-distributed
• Can adversely affect the ecology
• Upset other strategies
Chemical Method

- Note

Laboratory experiments showed that dispersants increased toxic hydrocarbon levels in fish by a factor of up to 100 and may kill fish eggs.

Dispersed oil droplets infiltrate into deeper water and can lethally contaminate coral. Research indicates that some dispersants are toxic to corals.
Dispersant Effectiveness Influencing factor

- Environmental conditions
- Mixing energy
- Oil viscosity
- Dispersant formulations
- Dispersant quality
- Application method
Dispersant

• What is dispersant?
  - solvent
  - surfactant

• What does it do?
  - Reduces surface tension
  - Redistributes oil into water column
Advantage of use

• Quick response
• Removes risk of:
  - shoreline contamination
  - potential fire hazard
• Reduces contamination of birds etc...
• Inhibits formation of `chocolate mouse`
• Cheaper than mechanical
• Improves biodegradation
Disadvantage of use

- Oil is not removed, re-distributed
- Can adversely affect the ecology
- Upset other strategies
Application rate control

Application rate = \textit{pump discharge rate} (litres/min)
0.003 \times \text{speed} (\text{knots}) \times \text{swath} (\text{m})
Other chemicals

- Emission breakers
- Gelling agents
- Herders
- Viscoelastic additives
- Bioremediation
- Burning agents
Biological Methods

- **Bioremediation**: use of microorganisms or biological agents to break down or remove oil; Examples of such bacteria are Alcanivorax bocumensis or Metylocella Silvestris.

- **Bioremediation Accelerator**: Oleophilic, hydrophobic chemical, containing no bacteria, which chemically and physically bonds to both soluble and insoluble hydrocarbons.
Bioremediation Contd

- The bioremediation accelerator acts as a herding agent in water and on the surface, floating molecules to the surface of the water, including solubles such as phenols and BTEX, forming gel-like agglomerations.

- Bacteria break down of hydrocarbons into water and carbon dioxide has shown 98% of alkanes biodegraded in 28 days; and aromatics being biodegraded 200 times faster than in nature they also sometimes use the hydrofireboom to clean the oil up by taking it away from most of the oil and burning it
Burning

- Direct burning
- Portable incineration
- Domestic/industrial incinerators
- Approved required
Burning

• Combustion requires:
  - igniter
  - low water content in oil
  - minimum of thickness (3mm)
  - specialized containment booms

• Safety

• By-products
  - air pollution
  - burnt residue
Other Clean Up Methods

- Controlled burning can effectively reduce the amount of oil in water, if done properly. But it can only be done in low wind, and can cause air pollution.
Other Clean Up Methods

- **Watch and wait**: in some cases, natural attenuation of oil may be most appropriate, due to the invasive nature of facilitated methods of remediation, particularly in ecologically sensitive areas such as wetlands.
Stabilisation

Quicklime/binding agent

Renders waste physically & chemically suitable for
- road construction
- landfill
- land reclamation
Shoreline clean-up

- Shoreline type
  - sensitivity
  - amenity
  - access
- Project management
  - labour intensive
  - low-technology
De-contamination

• Equipment, large/small
• Hand tools
• Personal protective equipment
• Cleaning stations
IMPACTS ON SEA CREATURES
Impact of oil spills: In the water

- Plankton
- Fish
- Aquaculture
- Marine mammals/turtles
- Shallow subtidal
Impact of oil spills: on the shore

- Tourist beaches
- Marinas
- Industry
- Shoreline energy
- Shore birds
Logistics

- Location of the spill
- Monitoring and surveillance
- Application method
- Quantity needed/re-supply/cost
- Storage
Communication network for Prevention and Control

SURVEILLANCE AIRCRAFT → FAX → OPERATIONS CONTROL CENTER

SURVEILLANCE SHIPS → PIPELINE ENGINEERS

COMMAND AND CONTROL SUPERVISOR
1st. LINE OF DEFENSE
CONTROL SPILL AT SOURCE

2nd. LINE OF DEFENSE
CONFINE, RECOVER AND/OR DISPERSE THE OIL

3rd. LINE OF DEFENSE
PROTECT SENSITIVE AREAS

4th. LINE OF DEFENSE
CLEAN UP OF AFFECTED AREAS
What not to do during clean-up operations

➤ Do not over clean; do not remove more sand and substrata than is absolutely necessary

➤ Do not let machinery or people run over contaminated beaches prior to cleaning.

➤ Do not use dispersants until approval is given by Ministry Of Petroleum.

➤ Do not pile oily sand higher than 60 cm.
Do not bury oily debris or plough it into the ground.

Do not drive the oil into inaccessible areas or tidal and sub-tidal zones. (Raking of the top layer of sand is however an appropriate way to accelerate biodegradation).

Do not destroy vegetation bordering the beach more than absolutely necessary, rather, accept slightly oiled spots.
REMEDIATION

• Removal of contaminant

• Restoration of environment

• Promotion of natural ecosystem growth
Types of Remediation

- Bioremediation
- Chemo remediation
- Physical remediation
  - *in situ remediation*
  - *ex situ remediation*
Bioremediation

"use of living organisms (e.g., bacteria) to clean up oil spills or remove other pollutants from soil, water, and wastewater."
*Source: United States Environmental Protection Agency, Office of Compliance and Assurance*

“clean-up of pollution from soil, groundwater, surface water and air, using biological, usually microbiological processes”
*Source: Philp et al., 2001*

Bioremediation relies largely on the enzymatic activities of living organisms, usually microbes, to catalyze the destruction of pollutants or their transformation to less harmful forms.
Bioremediation

A complex process depending on many factors including:

• ambient environmental conditions

• composition of the microbial community

• nature and amount of pollution present
Bioremediation techniques

- Natural attenuation
- Phytoremediation
Biostimulation
Natural attenuation

A Typical Hydrocarbon Plume Undergoing Natural Bioremediation;
(a) Cross Section, (b) Plan View

Legend:
- Aerobic Margins
- Residual Phase
- Anaerobic Core
- Water Table

(a) Cross Section

Oxygenated—Uncontaminated Groundwater
Flow

Hydrocarbon Source

An aerobic zone beneath the contaminant plume facilitates natural attenuation.

(b) Plan View

Oxygenated—Uncontaminated Groundwater
Flow
The Need for Remediation -

Oil Spill in Australia
The Need for Remediation

Environmental Degradation Due to oil spill in Niger Delta Area: Source AfriOil Week Magazine February 8, 2014
Approach to Application of RENA Technology

- Site Assessment
- Remediation by Enhanced Natural Attenuation

Decision Points:
- Soil Characteristics?
- Extent of Contamination?
- Feasibility of Excavation?
- Urgency

Application of Soil Remediation Method
Materials and Methods for RENA

• Methodology in line with
  – (i) Environmental Guidelines And Standards For The Petroleum Industry In Nigeria (EGASPIN)
  – (ii) Ebuehi et al., 2005
  – (ii) the standard procedure as provided by International Union for Conservation of Nature (IUCN) for remediation of impacted sites.

1. SITE CHARACTERIZATION
a. Determine the vertical and lateral extent of contamination plume
b. Determine land use
c. Determine estimated volume of substance
CONCEPTUAL MODEL OF CONTAMINANT PLUME FLOWING FROM A SOURCE AREA AND INTO THE WATER TABLE
Techniques Employed to Treat Contaminated Soil

- **Spiking of Contaminated Soil**: adding water uniformly to soften the soil and allow the water to penetrate the soil matrix.

- **Initial Tilling**: the soil are tilled in a week after they are spiked, that is mixing the soil and breaking lumps. This is done using shovel, composite sample are collected and sent to laboratory for physicochemical and microbial evaluation.

- **Secondary Tilling**: soils tilled and homogenized a week after the initial tilling. Then lumps are broken to very fine particles with shovel and a rake. The essence of tilling and homogenization is to uniformly distribute the petroleum contaminants and break up the soil lumps to fine particles thereby increasing the surface area. Soil samples are taken for analysis.
• **Windrow Construction**: Windrows/ridges are constructed after the secondary tilling of the site. The ridges measure about 2 feet high and 4 feet wide. The windrows are made to achieve better aeration and optimize the efficiency of the attenuated processes in action, which exposes the microorganisms to oxygen, and aids in the biodegradation process of the petroleum hydrocarbon. Soil samples are taken for analysis.

• **Breaking down of Windrows**: The windrows are broken down after standing for between 3 and 4 weeks, after construction. Soil samples are taken for analysis.
Techniques Employed to Treat Contaminated Soil *continued*

- **Addition of Water**: Water was added to the sandy soil to enhance the biodegradation of the petroleum hydrocarbons by the microorganisms when it penetrates the soil.

- **Addition of Fertilizer**: Fertilizer application is done manually by sprinkling the fertilizer over the contaminated area. The process enhances the biodegradation of the petroleum hydrocarbon.

- **Soil Sampling and Analysis**: The topsoil samples of the site are taken at intervals of two weeks from 0.3 metres deep. They were taken using an auger machine into polypropylene bags, free from hydrocarbon contamination. The soil samples are taken for immediate physico-chemical and microbial analysis.
Techniques Employed to Treat Contaminated Soil

continued

• **Physico-Chemical and Microbial Analysis:** Total phosphorous, total nitrogen and total petroleum hydrocarbon contents in the soil samples were determined by the method of Association of Analytical Chemists (1990).

• **Microbial Analysis**
  – *Total Heterotrophic Bacteria (THB) Count*
  – *Total hydrocarbon Utilizing Bacteria (THUB) Count*
Bioventing

**Typical Bioventing System**

- Monitoring Points
- Air Injection
- Blower
- Contaminated Soil
- \( \text{O}_2 \)
Airsparging

Figure 1
Simplified IAS System
Advantages and disadvantages of bioremediation

Advantages:

- cost effective option, as it does not involve any costly transportation of hazardous materials.
- it helps to reduce the opportunity for contaminants to be spread further during extraction and transportation.
- Bioremediation also does not normally have extensive equipment requirements, which further reduces cost.
Disadvantage

Disadvantages:

- limitations on the types of contaminants that it can remove effectively.
- relative sensitivity to environmental factors such as temperature, pH, and the presence of various other substances or organisms, many of which it can be difficult to predict the effects of.
Physical remediation: In-situ remediation
Soil flushing - *in situ*

- Apply water solution to enhance contaminant mobility
- Generated leachate intercepted
- Especially good for halogenated and high permeability
Physical remediation: Ex situ bioremediation

- Ex Situ bioremediation involves excavating contaminated soil
- Placing it into biotreatment cells
- Adding nutrients to enhance biological activity
- Periodically turning it over to aerate the water.
- The moisture, heat, nutrients, oxygen, and pH are usually controlled in the process.

- Separation of decontaminated solids
Ex situ bioremediation

A concept for an open-system slurry bioreactor process
Soil washing - *ex situ*

- Excavation
- Wash soil with leaching agent or surfactant
- Not effective with clay or high organic content
Phytoremediation

This is the use of plants to achieve the cleaning of oil spills.

Best Plants For Phytoremediation. Indian mustard (Brassica juncea L.) Brassica juncea (L.) – Indian Mustard. Willow (Salix species). Poplar tree (Populus deltoides). Indian grass (Sorghastrum nutans) (Sorghastrum nutans (L.) Nash) Sunflower (Helianthus Annuus L.) (Helianthus annuus L. common sunflower)
Advantages and Disadvantages of Phyto remediation

Advantages:
- much cost effective
- planting of trees improves aesthetics
- easy monitoring

Disadvantages:
- more applicable to land
- it is a slower process
Chemo remediation

This involves the use of chemical dispersant for oil spill clean up.

Some of the chemicals used include: COREXIT (Nalco) EC9500A and EC9527A

- Aerial and
- Boat spraying are the most common delivery systems
Methods of application

- **Aerial Spraying** - Aircraft provide the most rapid method of applying dispersants to an oil spill. For aerial spraying, the dispersant is applied undiluted. Careful selection of spray nozzles is critical to achieve desired dose levels, since droplet size must be controlled.

- **Boat Spraying** – Dispersant may also be applied by workboats equipped with spray booms mounted ahead of the bow wake. The preferred and most effective method of application from a workboat is to use a low-volume, low-pressure pump so the chemical can be applied undiluted.
CONTD.
CONTD.
SHORELINE ASSESSMENT
DEGRADED SHORELINE
The geography and topography of the coastal area directly effects how quickly the area will recover from the contact of the oil spill.

The higher energy that a coastline receives the faster that it will be cleansed of the oil damage, and naturally the less energy that a coastline receives the slower that it will be able to recover.

The sensitivity reflects this energy level - the higher the sensitivity, the higher the energy.
Processes following a spill

Source: www.ipieca.org
Fate and Effect of Spilled Oil
ENVIRONMENTAL CONCERNS
Environmental Impact

1. Introduces toxic substance into soil and water environment leading to the death of plants animals, fish, phytoplanktons, algae, crabs...

2. Smothering of bird and mammals.

3. Long term effect such as bio-accumulation in the food chain may result


5. Contaminates the plumage of bird.

6. Since two third of oxygen supply to the earth if form plants, the spill of oil could lead to reduction is oxygen generation
IMPACTS ON SEA CREATURES
Impact of oil spills: In the water

- Plankton
- Fish
- Aquaculture
- Marine mammals/turtles
- Shallow subtidal
Impact of oil spills: on the shore

- Tourist beaches
- Marinas
- Industry
- Shoreline energy
- Shore birds
Factor affecting Environmental Impact

• Oil characteristics

• Environmental conditions

• Shoreline type
Mangroves
value and uses

• Stabilisation & protection of shorelines
• Biologically productive habitat
• Fish/ prawn nursery & feeding grounds
  - supporting fisheries
• Nesting sites for birds
• Domestic & industrial wood supply
Mangroves
Oil spill vulnerability

• Assessment difficult
  - ground access impossible
  - aerial view obscured by forest canopy
• Tree mortality (toxicity & smothering)
• Oil may persist for many years
• Clean up can be demanding
  - restoration may be an option
Economic/Social Impact of Oil Spill on water

1. Loss of revenue/income for fishermen, tourism worker e.t.c.

2. Loss of value due to poor aesthetic community.

3. Oil causes irritation when in contact with the skin. It also causes dermatitis and the skin diseases.

4. Contamination of water bodies renders water non-usable to meet users needs.

5. Oil spill lead to social unrest and agitation by spill affected communities and sometimes loss of lives.
Financial Cost of Oil Spill

- Cost of Clean-Up
- Legal Cost
- Fines
- Compensation Cost
- Replacement Cost – Decontamination
- Surrogate Cost – Evacuation
- Medical Cost
Summarily

- Oil spill leads to pollution and contamination of land, water, air and groundwater
- Effect can be local, regional and global
- Oil spill management requires prevention, control and response planning
- Environmental Sensitivity and Characterisation is key to spill management
- Ecological Impact is long term and expensive
Thank you!