OIL SPILL MANAGEMENT

A PRESENTATION BY

ADEBIYI A. ADEOSUN

MANAGING CONSULTANT

PARADIGM ENVIRONMENTAL SYSTEM CONSULTANTS LIMITED

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.

Contd.

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 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

Oil related factors

Volatility

Specific gravity/API

Type/ Nature of the crude

Viscosity

Environmental factors

Nature of the environment (air, land and water)

Various climatic and environmental factors: temperature, wind speed, wave movement, porosity, soil structure and texture, soil profile, flora and fauna present in the environment etc.

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

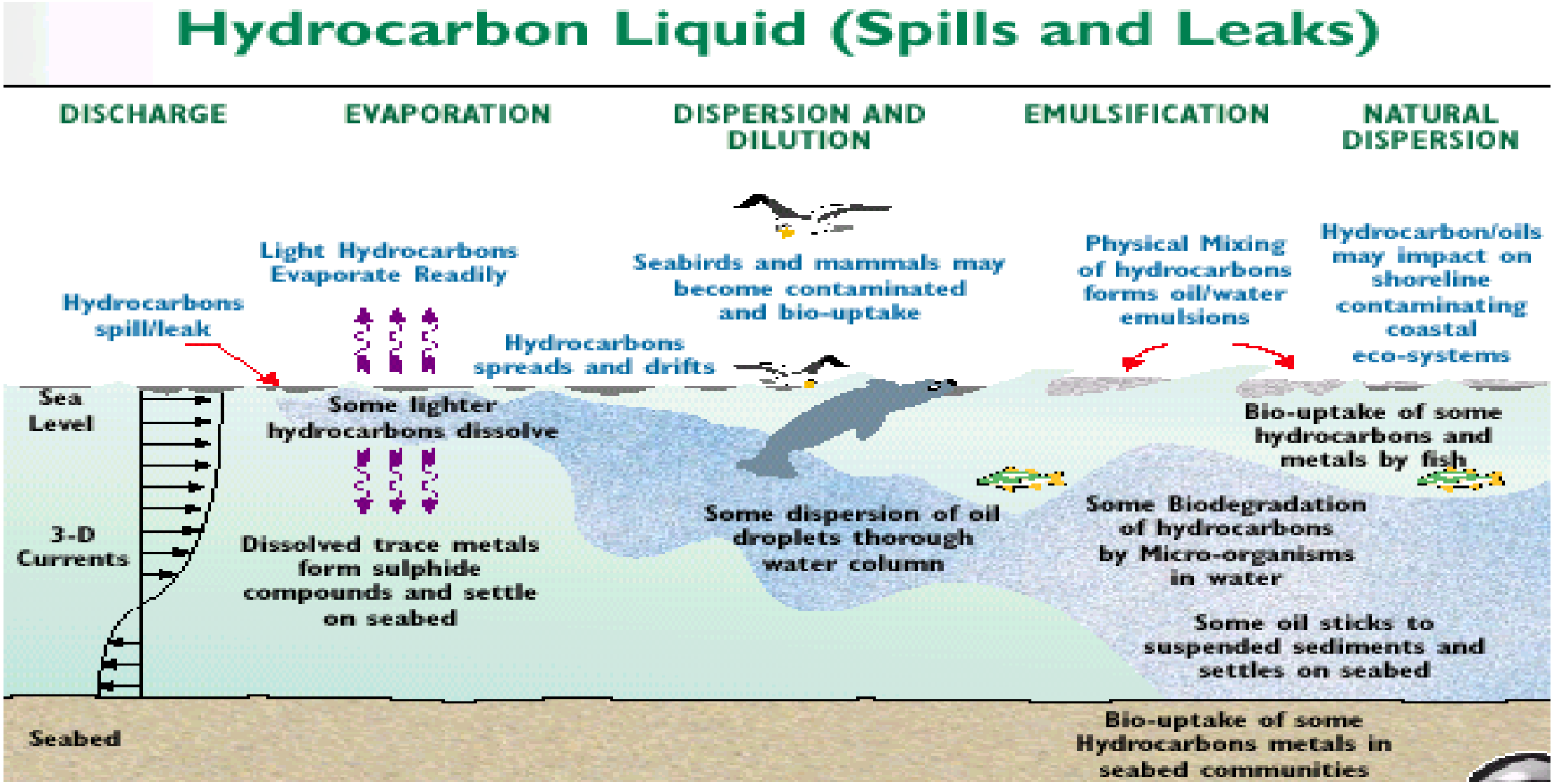
Weathered crude or "mousse" is crude petroleum that has lost much of its more volatile components and has mixed with sea water.

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.

Tarballs

Weathered Crude oil

Weathering processes of crude oil



Key consideration of Oil spill

They include:

- Toxicity
- Biodegrabilility/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

FIRST AID

Health Hazard Rating	Inhalation	Skin	Eyes	Ingestion
Corrosive	*D O* Remove to air See Doctor	*N O T* Rinse with water See Doctor	*D E L A Y* Rinse with water See Doctor	See Doctor
Severe Irritation	*DO NOT DELAY* Remove to air	Rinse with water See Doctor		See Doctor
Irritation	Remove to air	Rinse with	water	See Doctor
No effect	No	Specific		Measure

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:

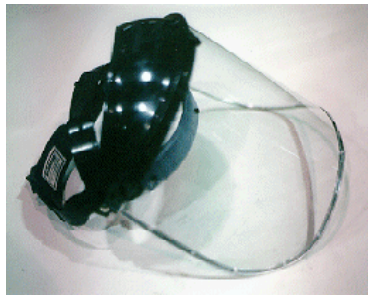
- To promote quick recovery.
- To prevent the situation from deteriorating.
- To save or preserve life.

ENVIRONMENTAL HAZARDS

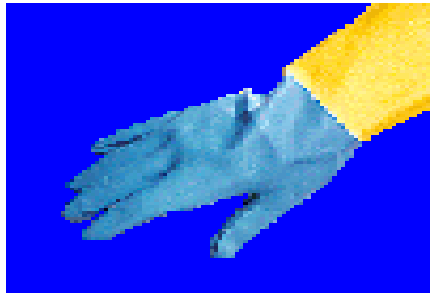
Considerations are:

- Toxicity
- Biodegrability/Persistence
- Bioaccumulation and tainting

Goggle



Face Shield



Neoprene

Hard Hat

Reinforced sole footwear

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
- Reclaimation
- 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

Desk top based

Practical on site simulations

Detailed planning

Simulation captured on video and used as learning tool

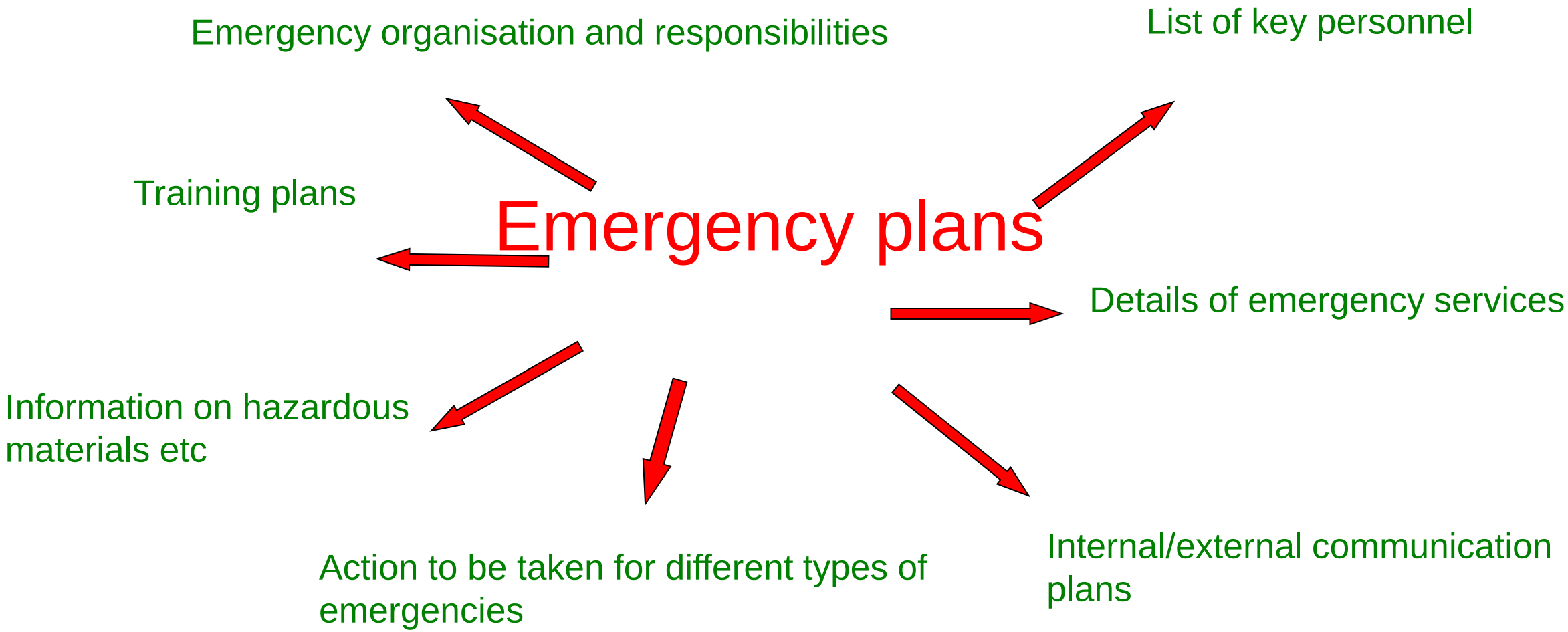
Assessment of procedures and individuals response

Emergency preparedness and response

Emergency preparedness and response → **Regular review and revision**

After an accident or emergency situation → Review procedures and revise where appropriate

Emergency preparedness and response



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.

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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

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Application rate control

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

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 Methylocella 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

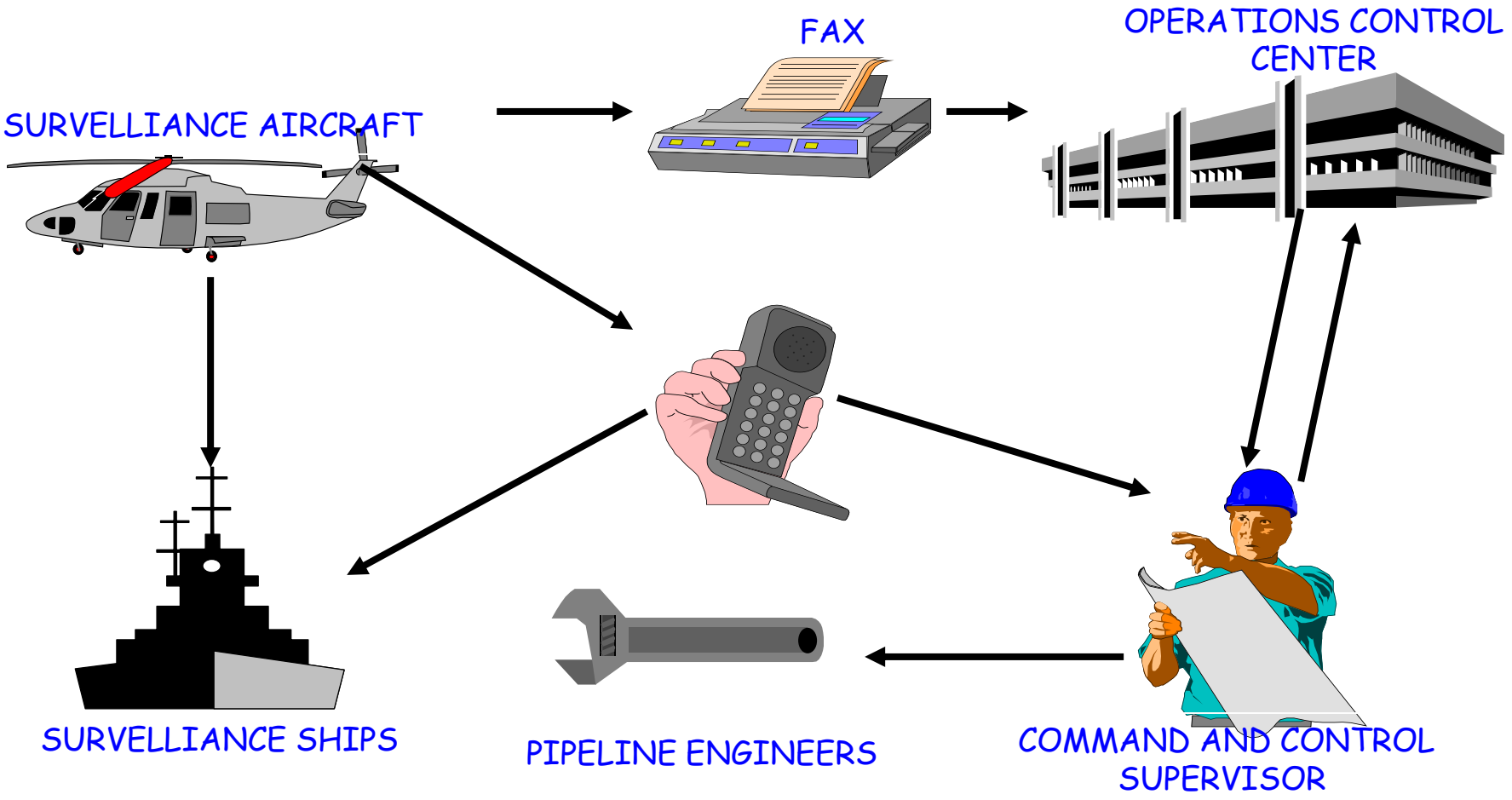
Impact of oil spills: on the shore

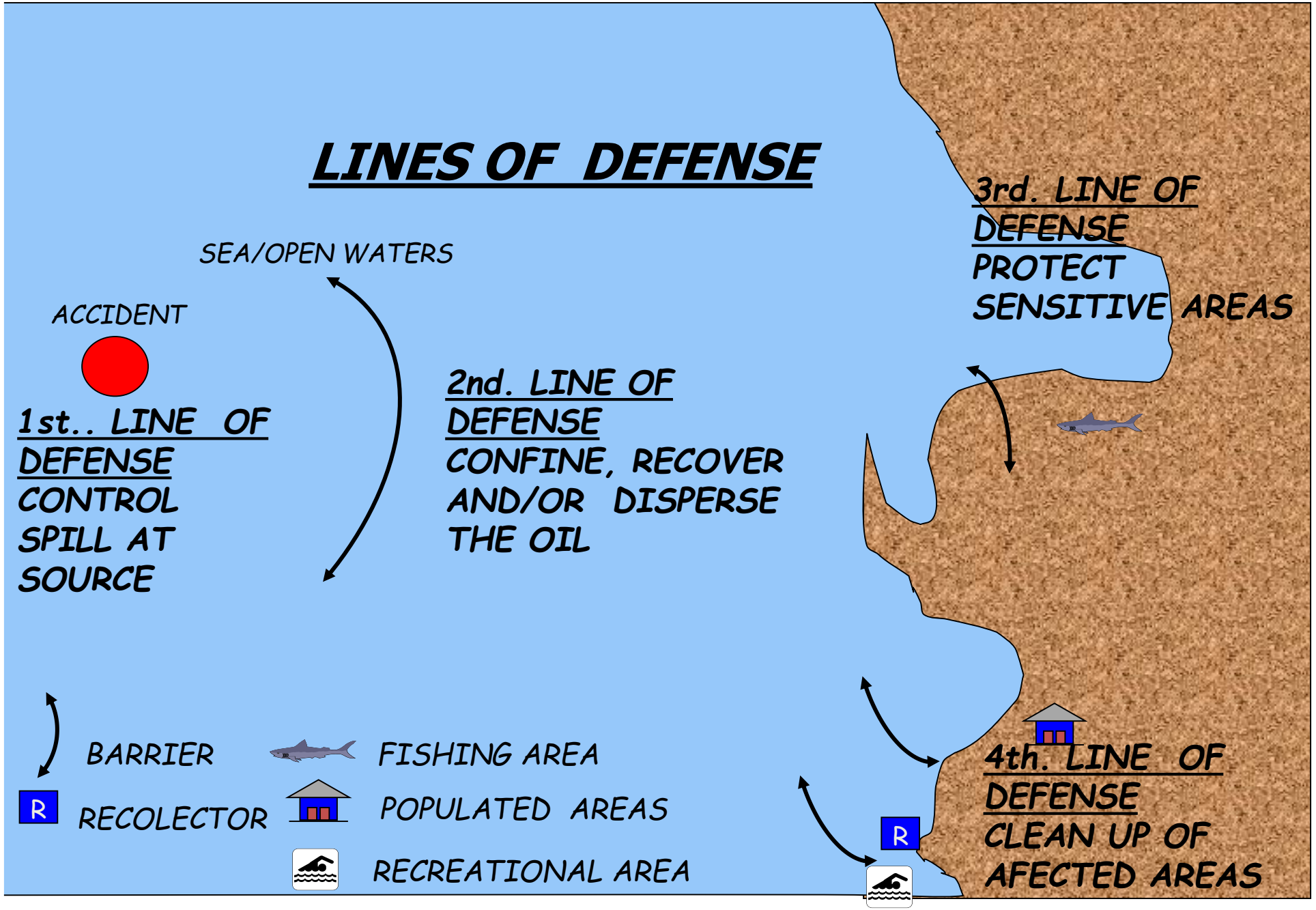
- Tourist beaches
- Marinas
- Industry
- Shoreline energy
- Shore birds

Logistics

- Location of the spill
- Monitoring and surveillance
- Application method
- Quantity needed/re-supply/cost
- Storage

Communication network for Prevention and Control




LINES OF DEFENSE
SEA/OPEN WATERS
ACCIDENT
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 AFECTED AREAS
BARRIER
R
RECOLECTOR
FISHING AREA
POPULATED AREAS
RECREATIONAL AREA
R

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.

Contd.

- 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

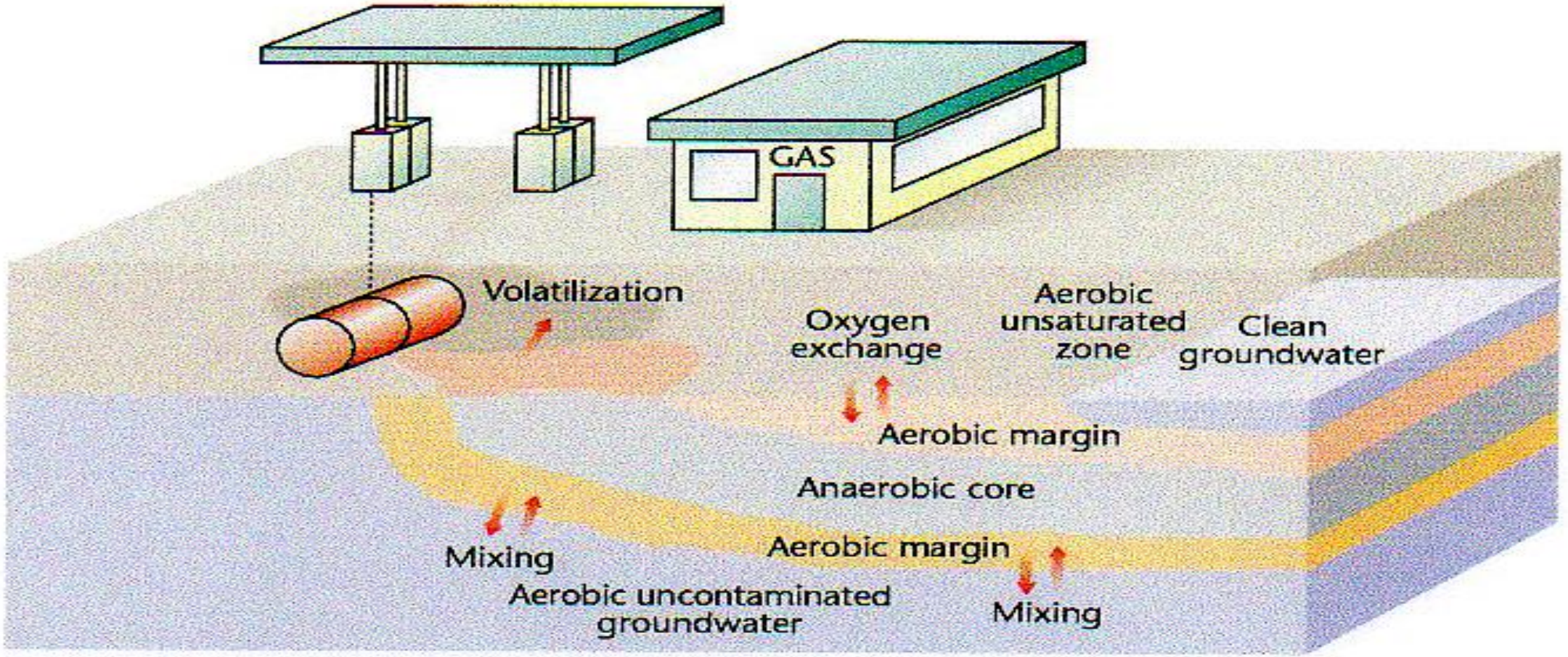
A complex process depending on many factors including:

- ambient environmental conditions
- composition of the microbial community
- nature and amount of pollution present

Bioremediation techniques

- Natural attenuation
- Phytoremediation

Biostimulation



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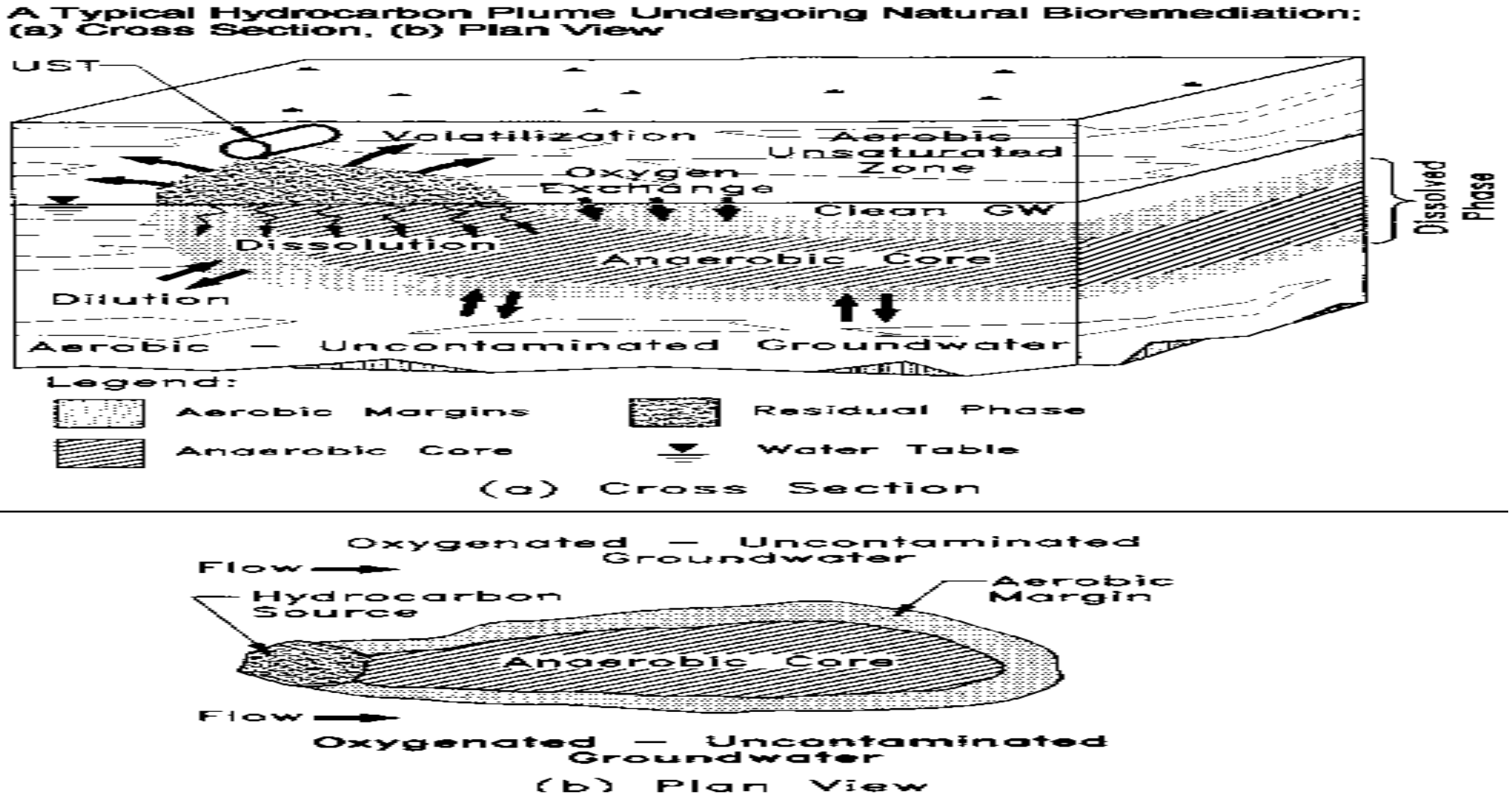
Natural attenuation



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

Soil Characteristics?
Extent of Contamination?
Feasibility of Excavation?
Urgency
Application of Soil Remediation Method

Site Assessment

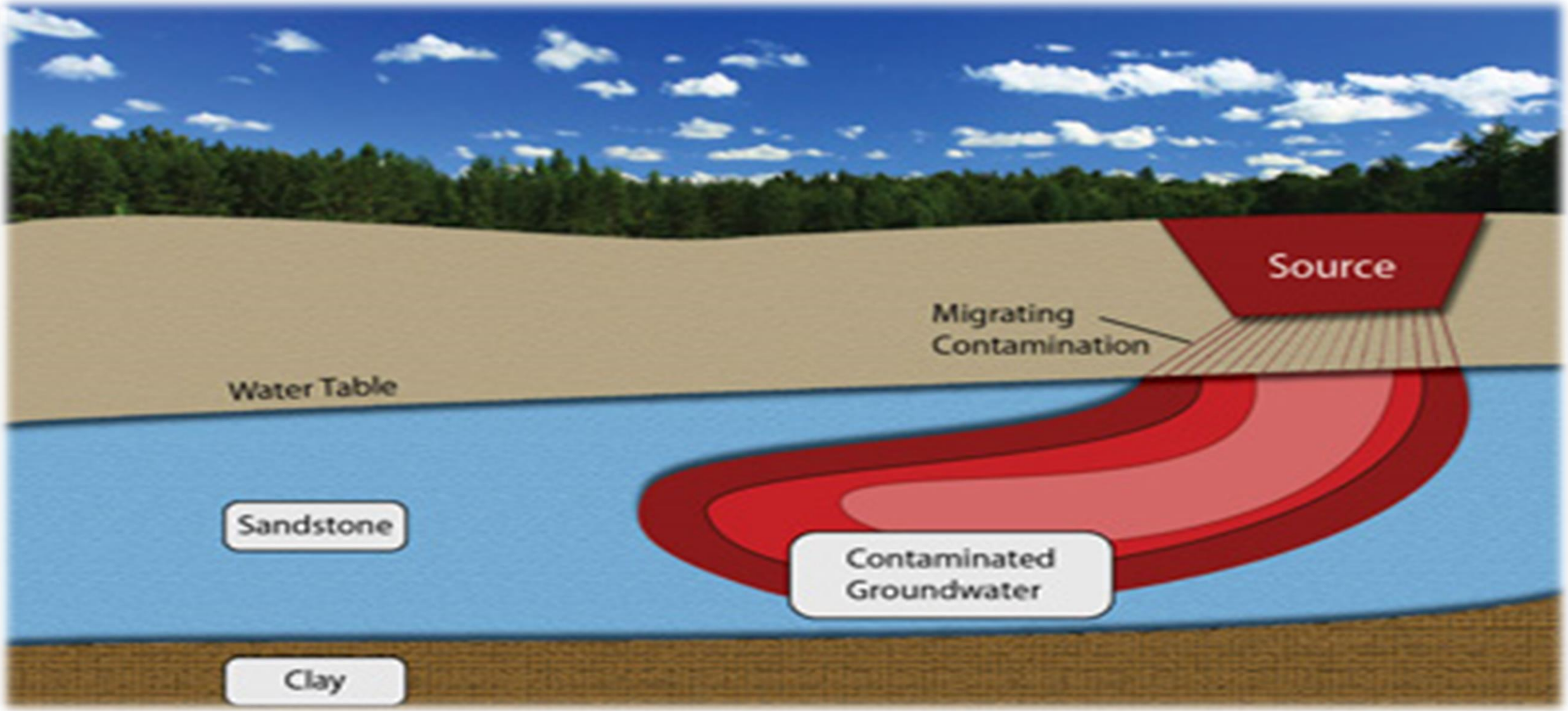
Remediation by Enhanced Natural Attenuation

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 particle thereby increasing the surface area. Soil samples are taken for analysis.

Techniques Employed to Treat Contaminated Soil *continued*

- **Windrow Construction**: Windrows/ridges are constructed after the secondary tilling of the site. The ridges measure about 2feet high and 4feet 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*

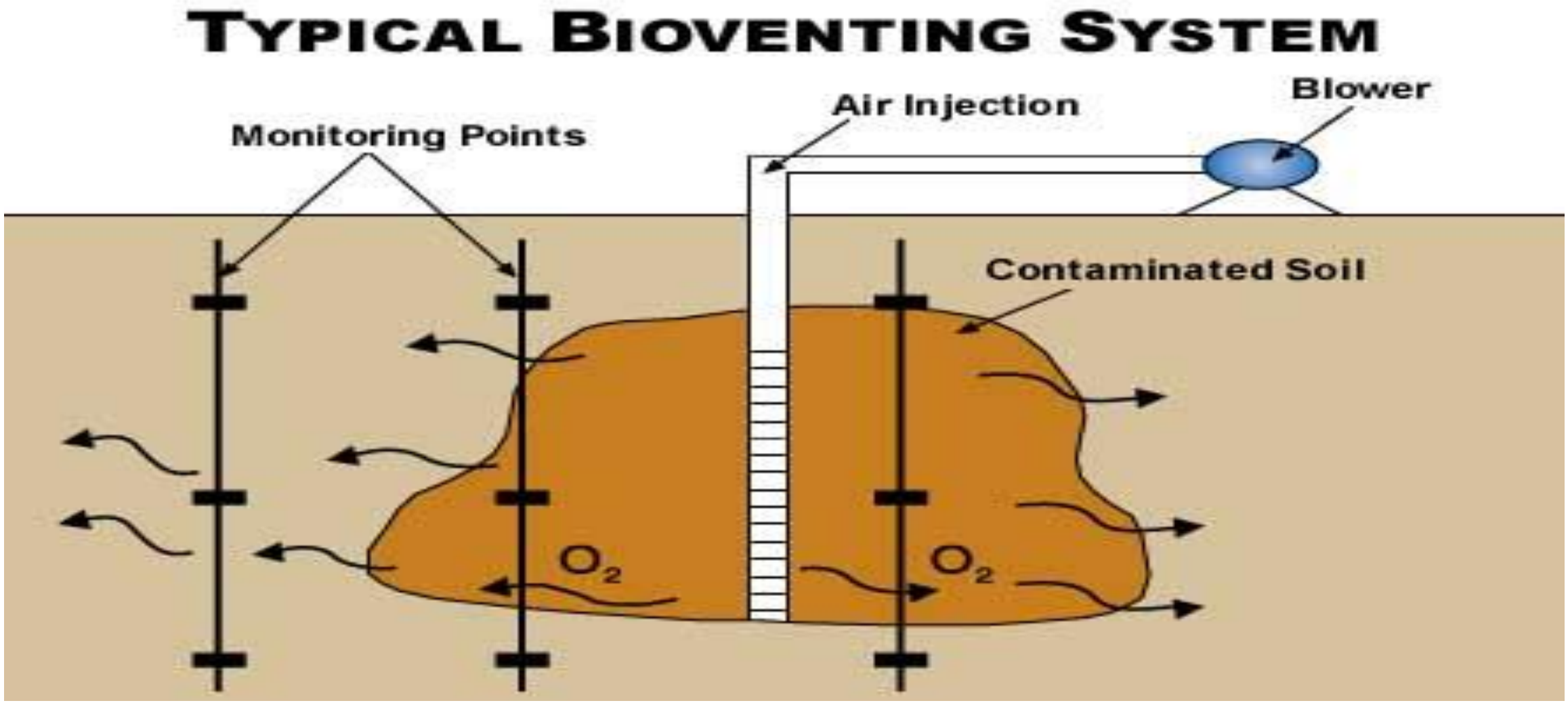
- ***Addition of Water:*** Water was added to the sandy soil to enhance the biodegradation of the petroleum hydrocarbons by the microorganisms when it penetrates the soil.
- ***Addition of Fertilizer:*** Fertilizer application is done manually by sprinkling the fertilizer over the contaminated area. 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 0.3metres 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 Utilizating Bacteria (THUB) Count***

Bioventing


TYPICAL BIOVENTING SYSTEM
Monitoring Points
Air Injection
Blower
Contaminated Soil
O2
O2

Airsparging

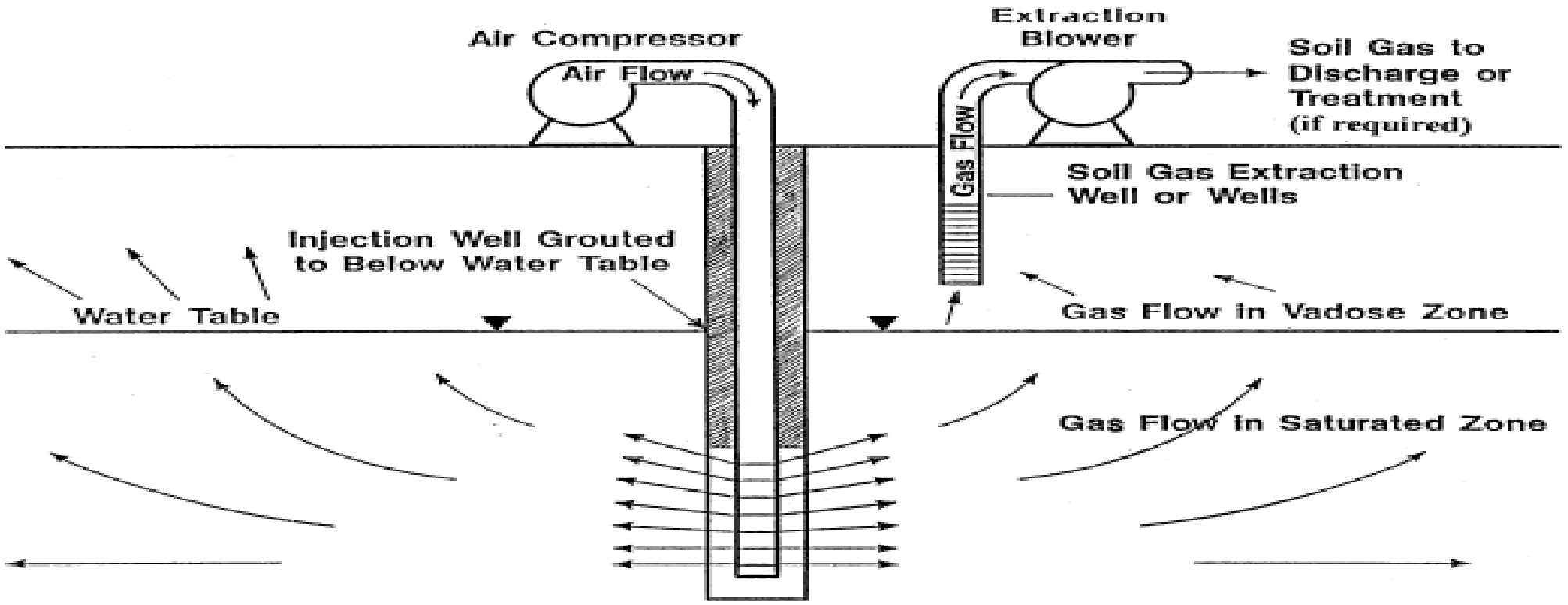


Figure 1
Simplified IAS System

Advantages and disadvantages of bioremediation

Advantages:

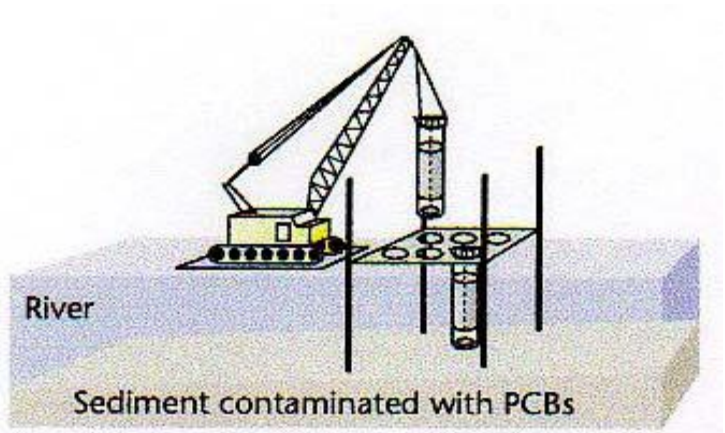
- cost effective option, as it does not involve any costly transportation of hazardous materials.
- it helps to reduce the opportunity for contaminants to be spread further during extraction and transportation.
- Bioremediation also does not normally have extensive equipment requirements, which further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



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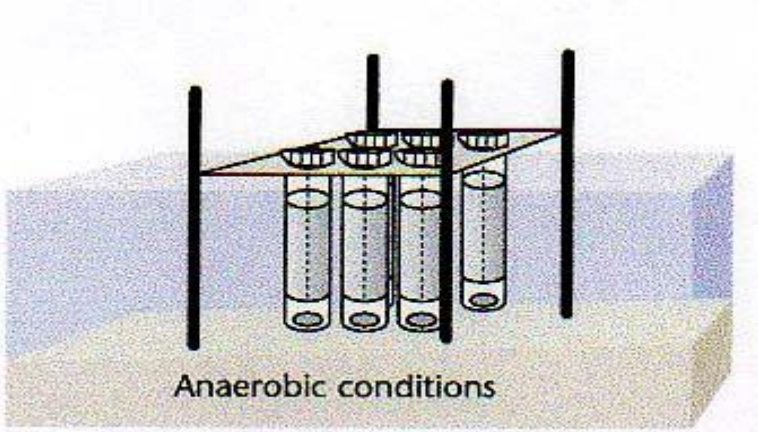

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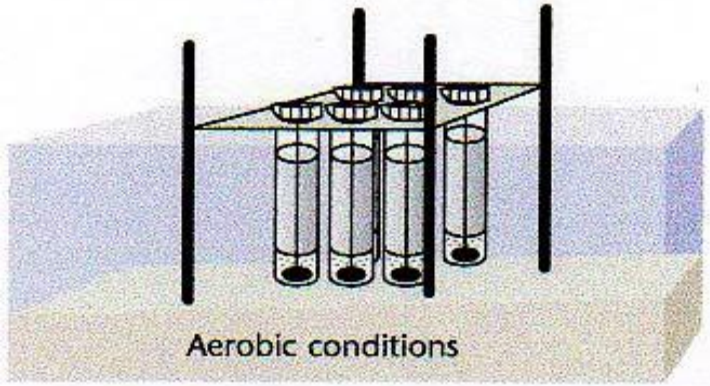
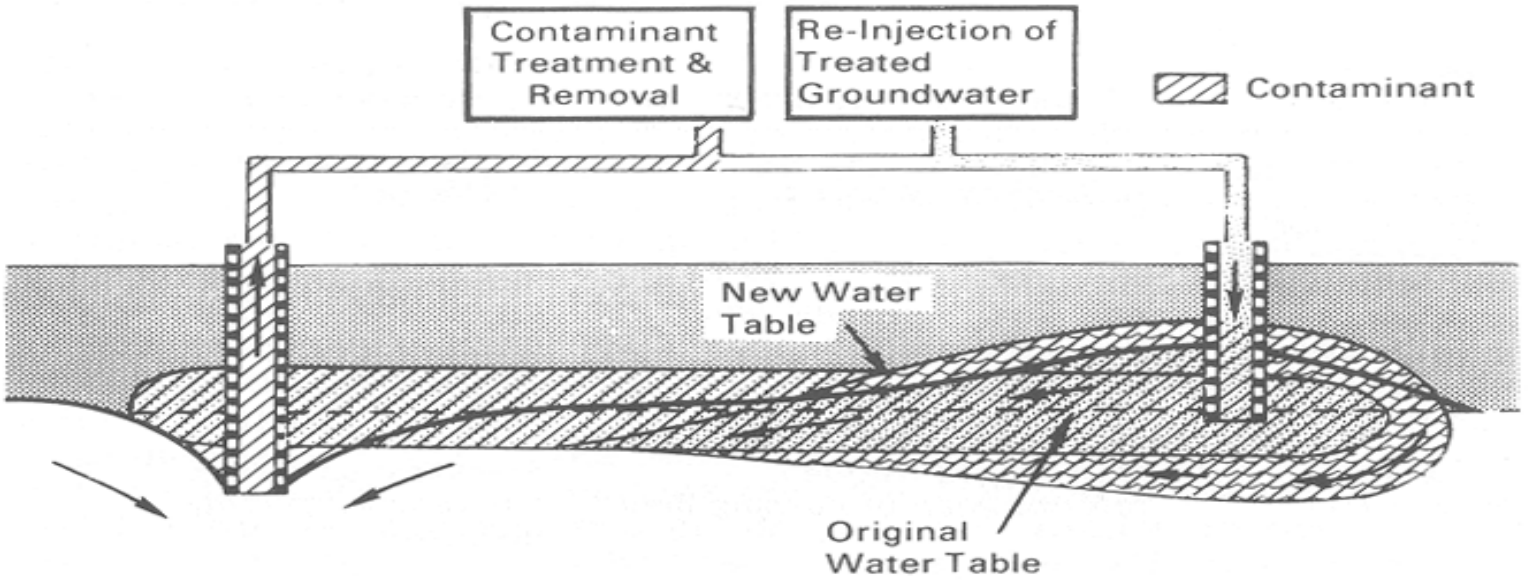


(c)

Soil flushing- *in situ*

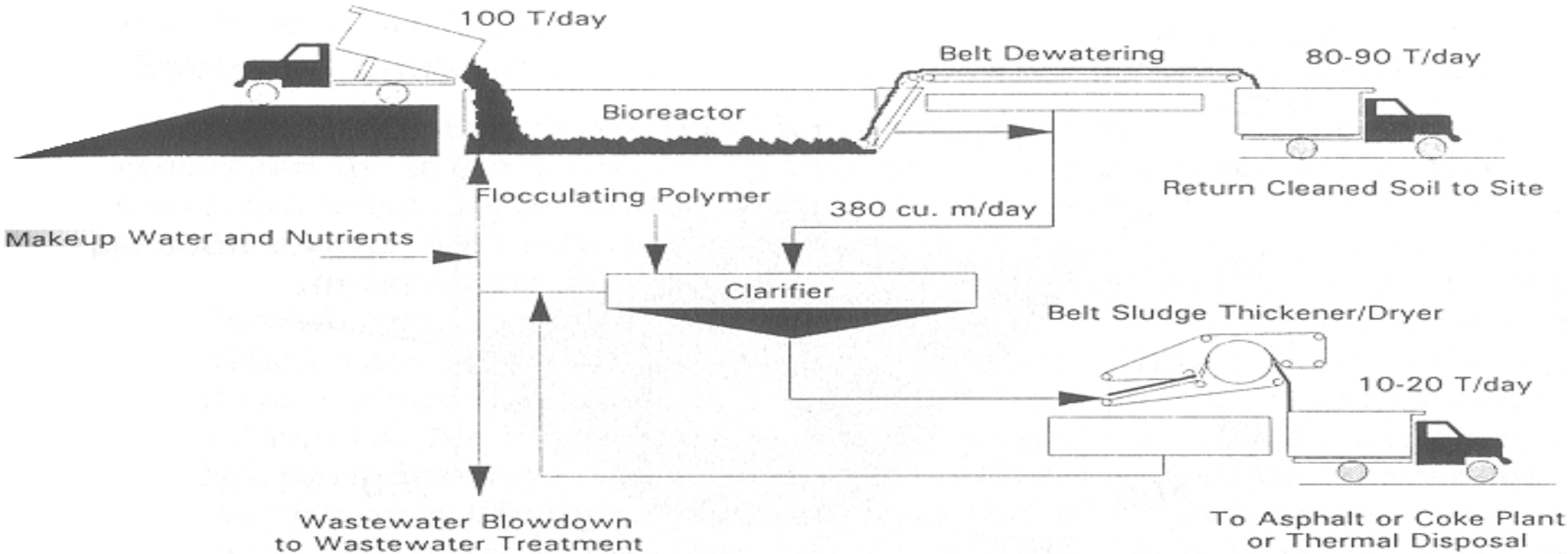


- Apply water solution to enhance contaminant mobility
- Generated leachate intercepted
- Especially good for halogenated and high permeabilility

***Physical remediation :Ex situ* bioremediation**

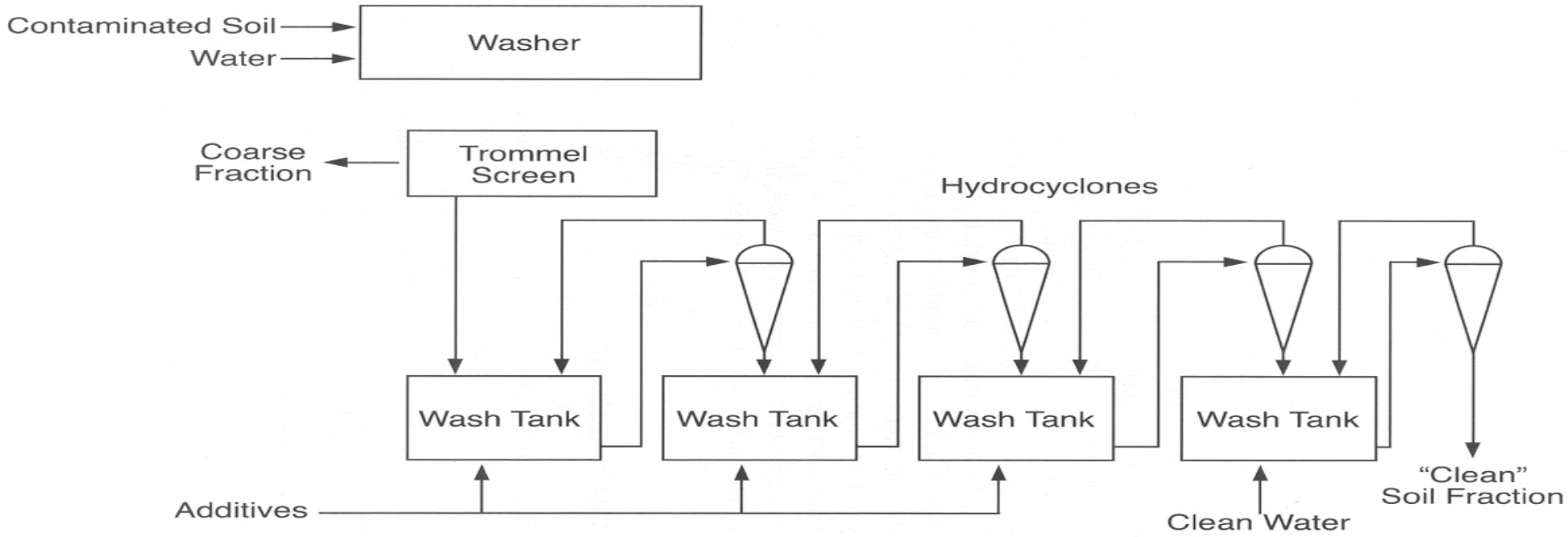
- Ex Situ bioremediation involves excavating contaminated soil
- Placing it into biotreatment cells
- Adding nutrients to enhance biological activity
- Periodically turning it over to aerate the water.
- The moisture, heat, nutrients, oxygen, and pH are usually controlled in the process.
- Separation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

PICTURES

CONTD.

CONTD.

BEFORE

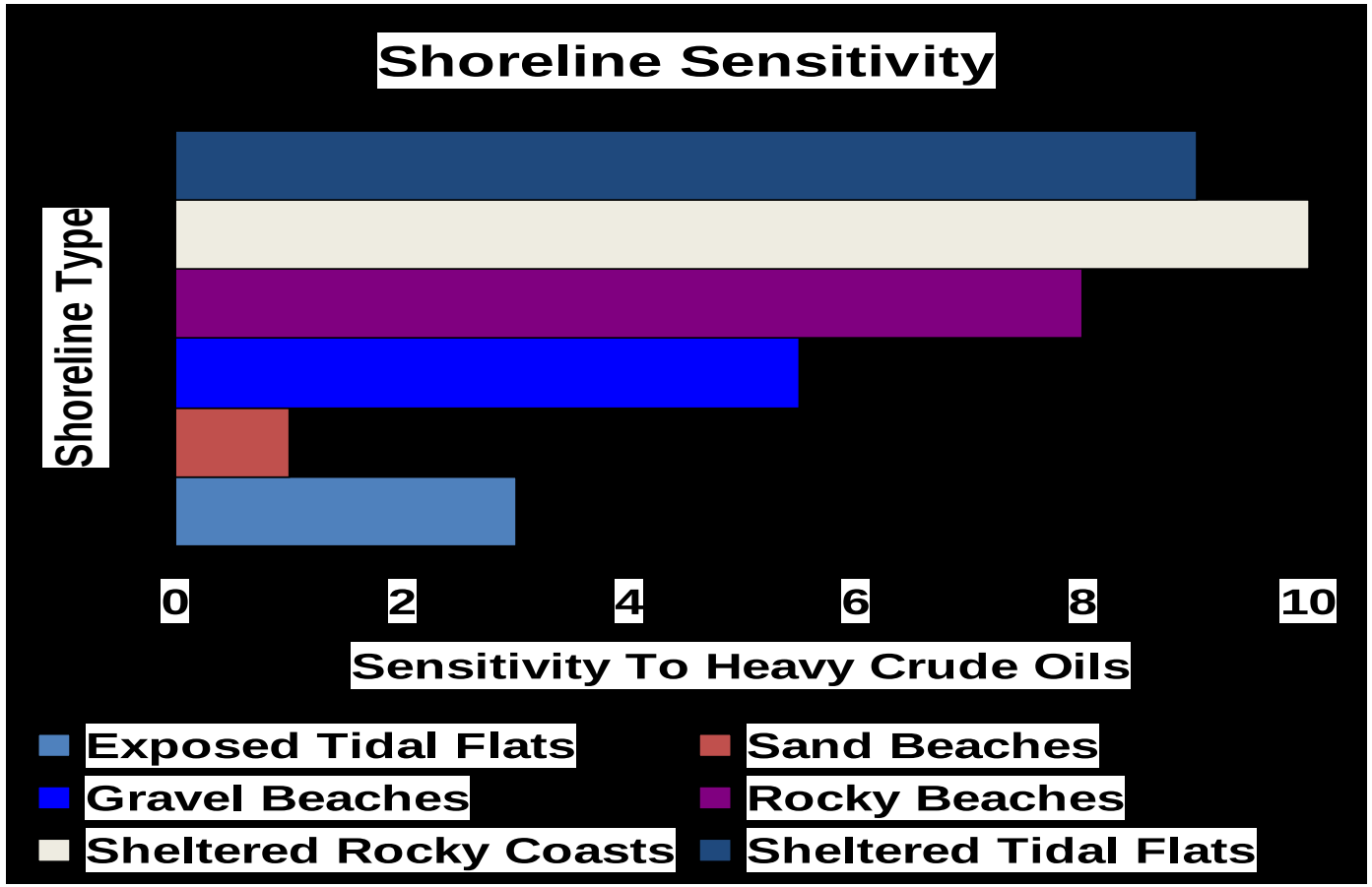
AFTER

SHORELINE ASSESSMENT

DEGRADED SHORELINE

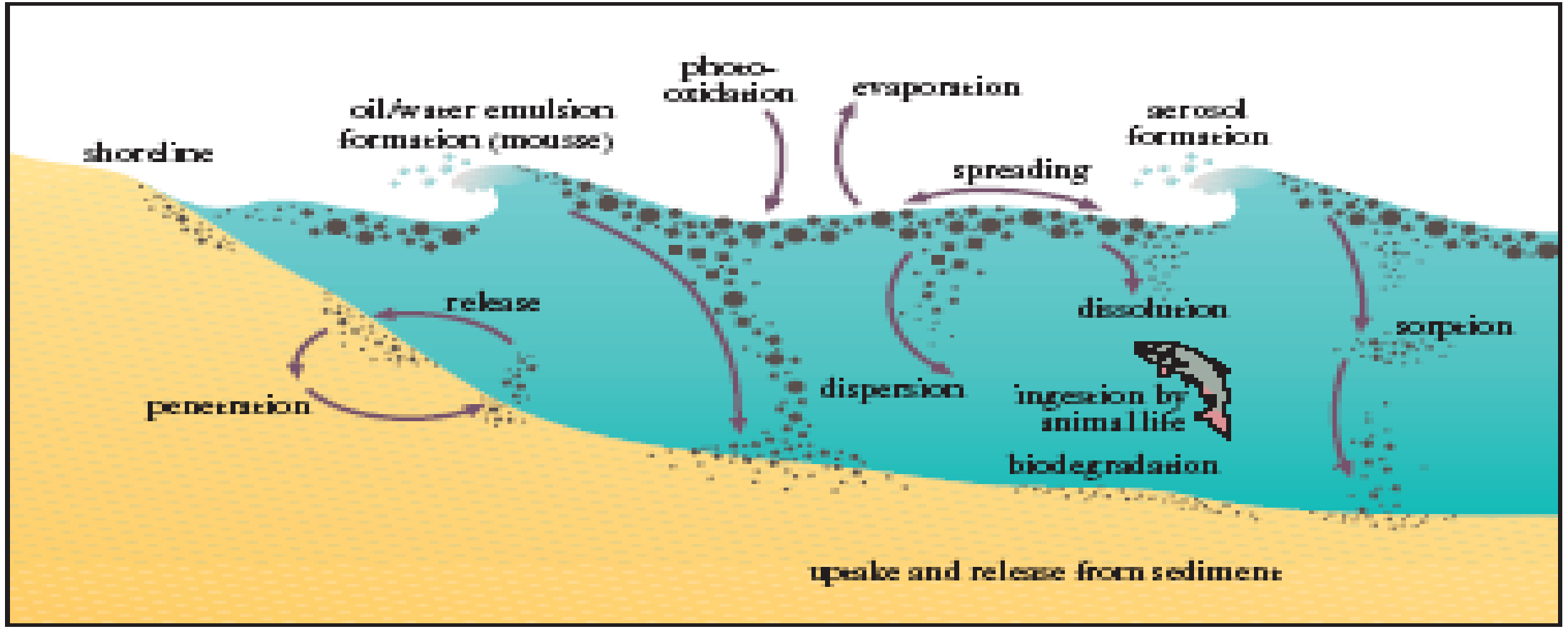
Shoreline Recovery

- 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

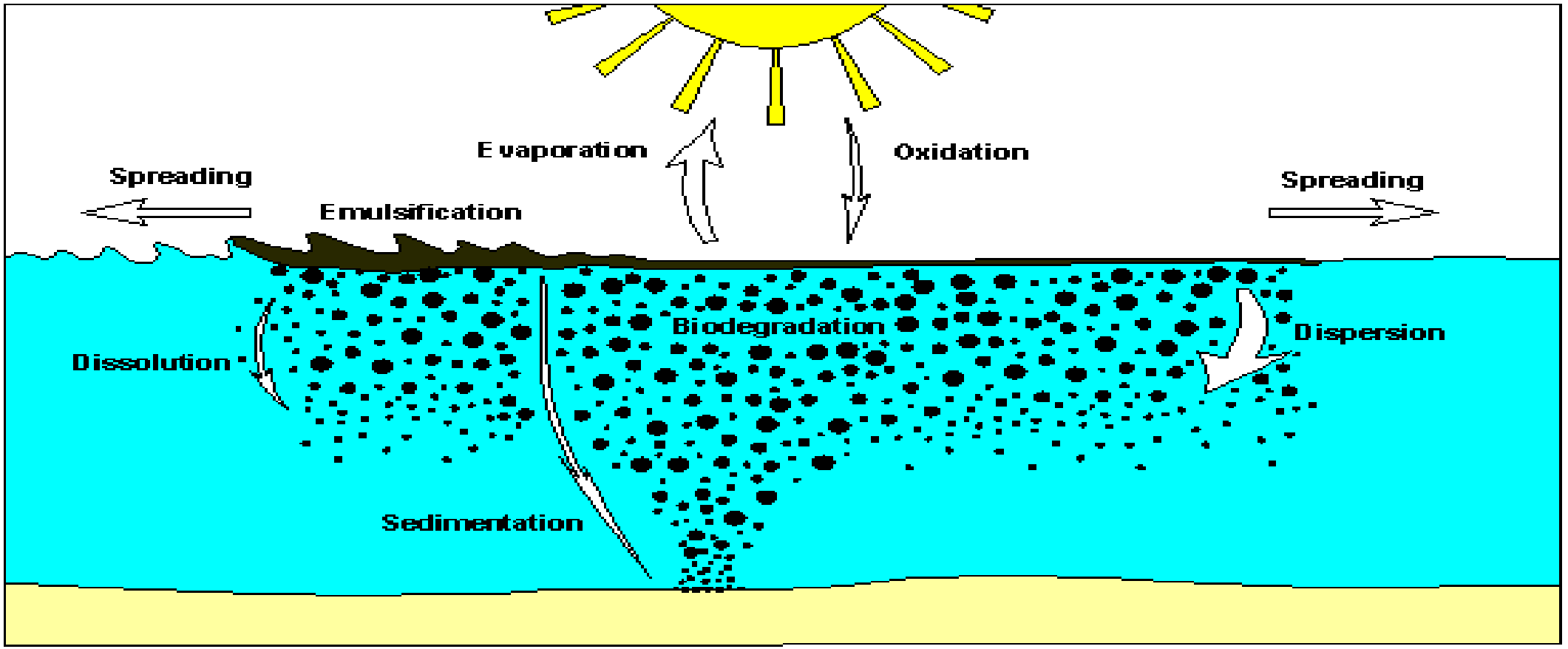


Processes following a spill

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
4. Water/Groundwater Contamination.
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!