STUDY ON BIODEGRADATION TECHNOLOGY APPLICATION IN BULK IN THE REMEDIATION OF SOILS CONTAMINATED WITH POLYCYCLIC AROMATIC HYDROCARBONS

Lect. Irina Ramona PECINGINĂ, Assoc. Prof. Roxana Gabriela POPA
„Constantin Brâncuşi" University of Tg-Jiu, irinacornescu yahoo.com

Abstract: *Biodecontaminare methods are based on biodegradation in the subsurface presence of microorganisms capable of degrading most of carbonaceous organic pollutants and much of inorganic pollutants. Biodegradation in bulk meet that principle biological decontamination several ways. These methods are intended solely for solids, and is often used for on-site remediation of soils contaminated with organic products. Station bioremediation ensure reducing the harmfulness of residues from oil exploitation activities considered hazardous, using a bioremediation process. Bioremediation process will lead to reduction of oil content and thus reducing the hazard of waste.*

Keywords: technology, soils, polycyclic aromatic hydrocarbons

1. INTRODUCTION

Crude oil and natural gas, as well as their secondary products, can affect all environmental factors (soil, water and air) and human life, animals and plants.

Among the negative effects that they have on the environment hydrocarbons are listed:

- destruction of vegetation
- destruction of soil fertility
- affecting the biological activity of the soil
- increase the toxicity of various substances, due to lack of oxygen in the environmental
- impairment of concrete and reinforced concrete structure laid underground constructions and installations

Biodegradation methods are based on biodegradation in the subsurface presence of microorganisms capable of degrading most of carbonaceous organic pollutants and much of inorganic pollutants.

Biodegradation is a natural phenomenon, because the soil, subsoil and groundwater is normal living environment for many microorganisms (bacteria, fungi) that has an action on biodegradable organic pollutants. Of these, bacteria predominate *(Pseudomonas, Bacillus, Arthrobacter* şi *Flovorbacterium)* and fungi *(Trichoderma*, *Penicillium* şi *Asperigillus).*

This type of decontamination is suitable for petroleum hydrocarbons (oil, light liquid fuel, gasoline, kerosene, mineral oils, benzene, toluene, xylene).

The efficiency of the biological decontamination of soils and groundwater depends on various factors:

• ***pollutants biodegradability*** is expressed in terms of their ability to degrade under the action of micro-organisms. The concentration and the distribution of pollutants in contaminated environment were also crucial in ensuring the biodegradability. Biodegradation is performing only within certain concentrations of pollutants. If it exceeds a certain threshold concentration of the pollutant in the environment, microorganisms can remain on the periphery of the contaminated area or be destroyed due to the high toxicity of pollutant.

- ***Type of microorganisms.*** Among microorganisms, bacteria ranks decontamination processes dominant in the soil and groundwater. Indigenous microflora of the polluted area can be the basis of microorganisms necessary decontamination. În necessary if it is proved that microorganisms are not native to biodegradation, microorganisms can use "specialized" that are developed on a mineral support (zeolites, carbon, composite materials) and then mixed with the contaminated environment.
- ***Choice oxidant and nutrient*** is always an important point in the feasibility of a biological decontamination operations.

Biodegradation in bulk meet that principle biological decontamination several ways. These methods are intended solely for solids, and is often used for on-site remediation of soils contaminated with organic products.

The basic principle of biodegradation in contaminated soil excavation consists bulk and arrangement thereof in the vicinity of the excavation, the technical conditions that favor natural aerobic biodegradation.

Source of microorganisms typically comes from the bacterial flora present in the soil, but there are situations where extra proceed to the addition of external microorganisms.

Composting is the oldest and the simplest technique of biodegradation in contaminated soil loose. For this method the contaminated soil is excavated and mixed with coarse organic material (straw, bark, manure) which favors aeration and nutrient role.

The resulting material is deposited on the soil by mixing in regular piles neighborhood have a circumference of several meters and a height of about one meter.

The main conditions to ensure acceleration of degradation are breathable, moisture and nutrient intake. To accelerate the biodegradation of pollutants proceed to enhancing soil aeration by regularly turning piles with mechanized equipment. Excavation of contaminated soil is the easiest physical method of remediation. It applies in cases of accidental pollution and soil point when pollutant may soon reach the water table.

The contaminated soil is excavated by mechanical means, where possible and where there are no conditions for the evacuation of mechanized excavation soil will be done manually, after which it will be transported to where it will apply step of biodegradation in bulk - composting. (Fig. 1)

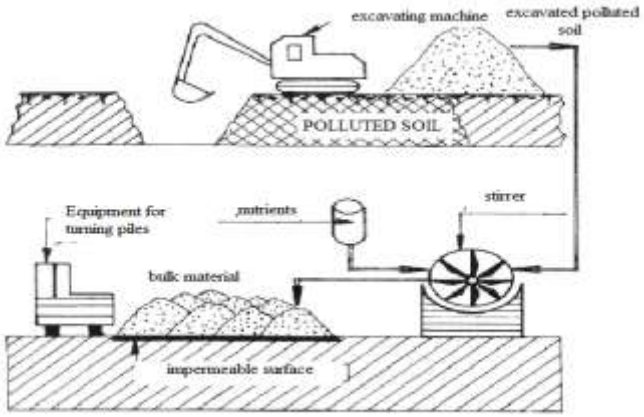

Fig. 1. Scheme for the application of composting in bulk

Excavation of polluted soil are obvious advantages: simplicity and speed of implementation, the possibility of full dismantling of the contaminated material and low cost execution. Some pollutants changing its characteristics after the execution of excavation work. Because of these issues, remediation method asola and polycyclic aromatic hydrocarbons is considered the most efficient bulk-composting biodegradation

2. MATERIALS AND METHODS. CASE STUDY

The location chosen to be addressed in the case study company OMV Petrom SA Group Deposits Ticleni area.

In terms of geomorphology, the location is within the area belonging to the common meadow and belongs Depression Jiu and Gilortului ture. It is located at a distance of over 2 km from the city Ticleni on land fallow, with neighboring forest areas. From geological point of view, belongs to Getic Depression studied area. Geological formations which occur in the upper part of the land belonging to the Quaternary, are generally composed of sandy clays, sands and gravels.

From the terms of soil, analyzed the lens is placed in a common meadow and belongs Depression Jiu and Gilortului ciency, attending classes with specific soils imposed by regional and local factors, conditions are favorable pedogenetical area argillic brown soil formation and development luvic and luvic soil.

In terms of hydrological, regional hydrographic network is represented by several major rivers alien and through a network of smaller rivers native, with frequent phenomena of drying up.

The main waste resulting from oil extraction activity consists of:

- soil contaminated with petroleum products (hydrocarbons) from the perimeters of the extraction and primary processing, as a result of accidental circumstances or due to phasing of wells or other facilities (parks tanks, compressor stations, etc);
- non-recoverable waste results

For processing and disposal of these waste types, management proposed a scheme that complies with national legislation in the field of waste management.

Such waste management scheme comprises:

- Treatment of mechanical, thermal and chemical sludge from lagoons and waste from tanks - will perform with mobile facilities and will contribute to the recovery and reuse of hydrocarbons contained in oil slurry;
- Treatment for biologically contaminated soil bioremediation role in stations to reduce oil content, aimed at reducing waste storage k;
- Use of treated soil meeting the limit values on soil quality, as filler in land cleanup related to oil fields and primary processing;
- Elimination of non-recoverable final demolition waste and waste treated by bioremediation which do not meet the quality requirements for use in remediation works by storing in warehouses for non-hazardous solid waste.

  Construction works of the cell will consist mainly bioremediation:
- scraping topsoil and storing it in specially designed areas, inside, in order to use to restore the land to the objectives of decommissioning subject (well, parks);

- existing land excavation depths varying depending on the target location and the need to ensure drainage slopes from all directions to the home collector;
- basic profiling platform bioremediation;

execution platform layer foundation;

- realization of asphalt waterproofing layer;
- prefabricated construction annexes (booth, laboratory, etc.);
- create system for collection, storage, pre-treatment and water circulation inside and furrow watering system.

Specific station bioremediation facilities are:

- The reception area and temporary storage of contaminated soil;
- Material storage area loosening;
- Bioremediation platform itself;
- Bioremediation material storage area;
- Drainage system and storm water storage tank for recycling;
- System of furrow irrigation water collected in the storage tank;
- Handling areas.

Station bioremediation ensure reducing the harmfulness of residues from oil exploitation activities considered as dangerous as using bioremediation treatment process. (Fig.2).

Fig.2. Overview of a wastewater bioremediation

The main stages that take place in the station bioremediation are:

• ***reception and temporary storage of contaminated soil***

• ***deposition result of mixing,*** soil nearby, regular heaps with a circumference of several meters and a height of about one meter, the technical conditions that favor natural aerobic biodegradation (Fig. 2. and fig.3.)

Submission of polluted soil is impermeable surfaces, removing the risk of migration of pollutants from contaminated soil in the ground support (fig. 4).

• ***bioremediation*** (processing - about 3 months). The process of biodegradation are developed in a chain reaction in which carbon compounds are converted by sequential degradation in the molecule becoming less complex, simple to obtain by-products, which include water and carbon dioxide. Waste treatment process involves the arrangement of the material received received on the platform surface and inducing optimal conditions for the

proliferation of microorganisms in the waste stream (bacteria) to biological degradation activity and consumption of existing organic product (petroleum hydrocarbons).

Fig.3. The process of mixing / aeration at a station in bioremediation

Fig. 4 Submission of soil material in bulk

Fig.5. Submission soil impermeable platform

For the growth of microorganisms necessary for the biodegradation of soil polluted with polycyclic aromatic hydrocarbons, must meet the following conditions: temperature 15 to 45 ° C (being dependent on the type of microorganisms); high permeability (permeability coefficient Kf> 10-6), pH = 5.5 -8.5. To accelerate the degradation process of the main conditions to be met are: aeration, moisture and nutrient intake (nitrogen, phosphorus, organic substances). Indigenous microflora of the polluted area can often constitute the basis of microorganisms necessary decontamination.The microorganisms present in contaminated soil are thoroughly examined by laboratory tests to elucidate possible decontamination without an additional contribution of non-indigenous microorganisms.

If biodegradation of petroleum hydrocarbons taking advantage of existing natural species in the soil, such as *Arthrobacter, Achromobacter, Novocardia, Pseudomonas, Flovorbacterium*. If, however, it turns out that indigenous microorganisms do not meet the microorganisms biodegradation can call "specialized" that are developed on a mineral support

(zeolites, carbon, composite materials) and then mixed with the contaminated environment.

• ***bioremediation temporary storage material.*** After treatment, depending on the concentration in petroleum hydrocarbons resulting material will have the characteristics of soil that can be used, as appropriate, to: filling cavities resulting from the excavation of contaminated soil and parks wells and storage tanks decommissioned in final permanent repository will be arranged in accordance with European standards by OMV Petrom SA at field cluster.

3. RESULTS AND DISCUSSION

The content of the material to bioremediation of petroleum hydrocarbons is estimated at around 5-6%. In carrying out bioremediation process is compulsory humidity by wetting, using rainwater stored in special tanks and oxygenation waste permanently placed in windrows, by loosening and mixing using a special machine.

Station bioremediation ensure reducing the harmfulness of residues from oil exploitation activities considered hazardous, using a bioremediation process.

Bioremediation process will lead to reduction of oil content and thus reducing the hazard of waste. It is expected that for some of the waste processed in hydrocarbon concentration to be reduced to the stage that will be allowed to use as filler in areas contaminated soil is excavated during decontamination operations.

4. CONCLUSIONS

The advantages of the bulk bioremediation are the following:

• pollutants are destroyed by conversion into water and CO2; are not transferred

• treatment is complete and aims at the same time soil, groundwater and air content in the soil

The disadvantages of bulk bioremediation method are as follows:

• technique can be used only for biodegradable substances

• when applied in situ soil permeability is required to be greater than 10-6 m/s

• if the phenomenon of pollution is generated by a mixture of pollutants, biodegradation can be inhibited because some pollutants can be toxic

• biological processes involved in biodegradation can sometimes generate toxic metabolites with an equal to or greater than the substances they come from

• stability metabolites may be greater than the substances they come from

• during decontamination is quite high

REFERENCES

[1] Lazar, M., *Ecological rehabilitation*, Publisher Universitas, Petrosani, 2001

[2] Neag, Gh., *Clean soil and groundwater* , Paper Science Publishing House, Cluj Napoca, 1997

[3] Pecingină, I.,R., *Environmental protection biotechnologies*, C.T.E.A. Publishing, Bucharest, pp. 195-206, 2010.

[4] Rauta C., Cirstea S, *Prevention and control of soil pollution,* Ed. Ceres, Bucharest in 1989.