

BALANCE OF PRODUCED WASTE IN LAGOONS OF THE FORMER OIL REFINERY IN KUÇOVA TOWN, ALBANIA

LALAJ Nensi, PRIFTI Irakli

Abstract. The District of Kucova, is a part of a higher administrative unit, Berat. The premises of the former refinery are located on a total area of about 25 ha. Currently, this site is without any industrial use; from the geomorphological point of view, the wider vicinity of the site can be characterized as a flat region with local elevations not exceeding 25 m. The former refinery lies in the floodplain of the Driza valley. The highest point of the premises is located on a Neogene elevation, which runs through the western part of the premises and reaches an altitude of about 53 m. The lowest-lying part of the premises reaches an altitude of about 36 m. The oil refineries in Kucova had a great impact on the environment. Currently, they do not work and are sold for scrap. However, the environment is still polluted by petroleum products remained from the former refinery. In this paper, we will discuss only about the former oil refinery in Kuçova town. The article is the result of research work carried out by different institutions. The results refer to the year 2011. The surveys were performed during subsequent years. All the technological facilities of the former refinery caused environmental pollution. The main hot spots of contamination are the lagoons. Lagoons caused the greatest impact on the environment. Technological wastes were discharged into them and are stored for many years. The authors' goal is to determine the amount of contaminated waste in the lagoons. In the area of the former refinery, there are 6 lagoons. Two lagoons (No. 1, 2) have the technological waste of distillation units, referred to as asphalt storage lagoons; in two lagoons (No. 3, 4), there are deposited acid wastes; in the lagoons no. 5 and no. 6, there are deposited coke technological waste. Lagoons are separated into two products: Waste volume (13,500 m³) and produced waste volume (> 2.0831 million m³). This is a unique case study for the pollution level in Albania, highlighting contamination and the impact on the environment.

Keywords: former oil refinery, lagoons, tars, produced waste.

Rezumat. Balanța deșeurilor produse în lagunele fostelor rafinării petroliere din orașul Kuçova, Albania. Districtul Kucova este o parte a unei unități administrative mai mari, Berat. Incinta rafinării se extinde pe o suprafață totală de aproximativ 25 ha. În prezent, aceasta nu are nici o utilizare industrială; din punct de vedere geomorfologic, cea mai mare parte a arealului limitrof poate fi caracterizat ca o regiune plană, cu ușoare înălțări locale ce nu depășesc 25 m. Fosta rafinărie se află în lunca văii Driza. Cel mai înalt punct este situat pe o zonă neogenă care trece prin partea de vest a incintei și ajunge la o altitudine de aproximativ 53 m. Partea cea mai joasă are o altitudine de aproximativ 36 m. Rafinăriile de petrol din Kucova au avut un impact mare asupra mediului. În prezent, acestea nu funcționează și sunt vândute la fier vechi. Cu toate acestea, mediul este în continuare poluat cu produse petroliere ce au rămas de la fosta rafinărie. În această lucrare, vom discuta doar despre fostele rafinării de petrol din orașul Kucova. Articolul este rezultatul unei cercetări efectuate de către diferite instituții. Rezultatele aparțin anului 2011. Anchetele s-au desfășurat pe parcursul anilor următori. Toate facilitățile tehnologice ale fostei rafinării au cauzat poluarea mediului. Principalele puncte fierbinți de contaminare sunt lagune. Lagunele au provocat cel mai mare impact asupra mediului. Deșeuri tehnologice au fost evacuate în ele și sunt păstrate timp de mulți ani. Scopul autorilor este de a determina cantitatea de deșeuri contaminate din lagune. În zona fostei rafinării sunt 6 lagune. Două lagune (nr. 1, 2) au deșeuri tehnologice provenite de la unitățile de distilare, denumite iazuri de depozitare de asfalt; două lagune (nr. 3, 4) au deșeuri acide; în lagunele nr. 5 și nr. 6 sunt depozitate deșeuri tehnologice de cocs. Lagunele sunt separate în două produse: Volumul de deșeuri (13.500 m³) și volumul de deșeuri produse (> 2,0831 milioane m³). Acesta este un studiu de caz unic pentru nivelul de poluare din Albania, care subliniază contaminarea și impactul asupra mediului.

Cuvinte cheie: fosta rafinărie de petrol, lagune, gudron, deșeuri produse.

INTRODUCTION

In 1934, the refinery in Kucova started its operation with lamp-oil production; it belonged to the Italian company AIPA. In 1944, the refinery passed into the property of the state enterprise. Since 2008 to the present time, the owner of the refinery and land has been the Town of Kucova (Municipality of Kuçovë, 2004; 2005; 2008).

The site concerned has been used for industrial purposes since the mid-20th century. In 1934, at the site, the operation of an oil refinery was started in the old plant. This plant was gradually extended; new technological equipment was installed in order to increase production and the effectiveness of the production process. In 1963, the operation was launched in a new, separated plant, which was located in the close proximity to the old plant. The refinery was definitively closed down in 1992.

Currently, the former oil refinery is without any industrial use. Up to this day, 2016, about forty smaller buildings and structures have been preserved from the era of the refinery and other buildings illegally constructed. At present, the premises are not safeguarded against the entry of unauthorized persons and therefore it is inhabited by 100 – 150 persons without authorization. Residents created small gardens between the lagoons (dykes). They plant vegetables and use water from the lagoons. This is an extreme case of how to live in a polluted area. The former refinery area lies within the residential areas and increases the impact on the environment.

In area of the former oil refinery and outside it, particularly in the proximity of the northern and eastern margins, there are several functional oil wells with operating equipment. Conducted studies have assessed a large volume of waste produced in the lagoons. This is done to precede subsequent projects for environmental rehabilitation.

MATERIAL AND METHODS

The amount of Waste and Waste products are calculated on the basis of three methods: Topographic survey; Geophysical survey; Digging holes and drilling of wells without rallied.

The topographic survey is conducted by licensed companies. The results of the topographic survey are presented in the archive of the Municipality of Kucova. On the basis of this report there is estimated the surface of lagoons. In this area, there are not included the dykes between the lagoons (Fig. 1).



Figure 1. Topographic map of the lagoons and east are of former petroleum refinery (original).

Environmental study. This is performed to estimate the thickness of the waste produced in the lagoons. These works are carried out according to the approved methods. There are also digging pits and drilled wells (no casing) to measure the thickness of the produced waste. On the basis of these methods, there are defined the sizes of the lagoons and the corresponding volumes are calculated.

RESULT AND DISCUSSION

Based on the above methods there are calculated the surface, the thickness of free phase of waste and their volume.

Balance of waste of the lagoons no. 1 and 2. The maximum verified thickness of asphalts deposited in the lagoons no. 1 and 2 was 0.5 m. The total area of the lagoons and the general balance of the vacuum residues (asphalts) are shown in the following table.

In case of lagoon no. 1, the presence of ps (petroleum substances) contamination was sensorially and analytically verified at a depth interval of 0.2 – 2.7 m of underlying soils in the area adjacent to the foot of the Neogene elevation. It is not certain whether the contamination is connected with wastes deposited above the soils or whether it is rather transport contamination originated from another area. In a part of the lagoon no. 1, which lies closer to the axis of the valley, the presence of contamination of underlying rocks was not detected (Fig. 2).



Figure 2. Topographic map of the Lagoons 1 - 6 (original).

Table 1. General balance of wastes (asphalts) deposited in the lagoons no. 1 and 2.

Lagoons	Area (m ²)	Average thickness of asphalts (m)	Volume of vacuum residues deposited in the lagoon (m ³)
1	3,500	0.4	1,400
2	6,000	0.3	1,800
TOTAL			3,200

Beneath the lagoon no. 2, we mention the presence of a contaminated layer of sandy clays sometimes of about 0.5 m in thickness. Theoretically, a very limited amount of potential contaminated leachates from wastes can penetrate this layer and reach the underlying layer of water-saturated highly sandy clays (Table 1).

Some diggings located in the southern dyke of the lagoon no. 2 verified the presence of a contaminated layer of slightly sandy clays at a depth interval of about 1.0 – 2.0 or 2.0 – 3.0 m, respectively. A layer of fills with waste was detected in other digging at a depth interval of about 1 to 2 m. Contamination of slightly sandy clays can originate from overlying layers containing waste, from where it can spread farther down to the underlying layer of water-saturated highly sandy clays. It may also be caused by the accumulation of contaminants in the zone of groundwater fluctuation; groundwater transports contaminants from other parts of the former oil refinery.

Balance of waste of the lagoons no. 3 and 4. Tars (acid substances) were deposited in these lagoons in the past. The survey verified their presence in both the lagoons and they have a maximum thickness of 0.8 m. The following table shows a general calculation of the balance of tars deposited in these lagoons.

The presence of contamination, besides wastes, was detected by sensorial evaluation in all dug holes, practically in its entire thickness, which ranges from about 1.5 m. to 3.5 m. and is predominantly represented by clays to sandy clays. The total area of contaminated soils underlying the wastes can be estimated on the basis of the known surface area of the lagoons at about 12,000 m², including dykes (Table 2).

Table 2. General balance of wastes (tars) deposited in the lagoons no. 3 and 4.

Lagoons	Area (m ²)	Average thickness of tars (m)	Volume of tars in the lagoons (m ³)
3	7,700	0.5	3,850
4	4,400	0.5	2,200
TOTAL			6,050

Balance of waste of the lagoons no. 5 and 6. Wastes from the coking operation were deposited in these lagoons in the past. When the survey was conducted, the ground in this hot spot was so inaccessible that the planned survey work could not be carried out. Based on consultations with the representatives of the former management of the refinery, the maximum thickness of the deposited waste could be about 0.5 – 1.0 m. The surveyed surface area of the lagoon no. 5 is of about 2,900 m² and of the lagoon no. 6 of about 1,200 m², altogether about 4,100 m². Due to the absence of data from the field survey and details on the character of operation, no balance was prepared for this type of waste. An estimate of the volume of waste deposited in the lagoons nos. 5 and 6 is 2,050 to 4,100 m³.

Evaluation of the balance of wastes. The above-given general balances of the lagoons of wastes occurring at the site of concern, i.e. vacuum residues (asphalts) and acid residues on oil refining (tars). The vacuum residues were primarily dispatched outside the premises for further processing.

Due to the fact that we could not manage to find out the length and frequency of technological shutdowns and periods of falling-off demands for vacuum residues through the study of archive materials, the calculation of the volume of vacuum residues in the lagoons is only for orientation. It is necessary to emphasize that since the end of operation of the refinery, the material from the lagoons nos. 1 and 2 has been manually excavated by people for secondary use, thereby reducing the volume of the dumped waste. By comparing the volume of vacuum residues deposited in the lagoons to their total production it arises that the remaining dumped waste is the mere fracture of the total volume of the production of this type of waste.

When calculating the balance of tars, we considered the situation that all the produced volume of tars was deposited in the lagoons inside the premises of the refinery from the beginning of the production of lubricating oils. As compared to the calculation of the volume of tars dumped in the lagoons no. 3 and 4, based on a field survey, the balance can be considered as even.

The following estimate of the balance of volumes is prepared for wastes dumped in the lagoons nos. 1 to 6. The balance of contaminated soils could not be made because of the low degree of exploration (Table 3).

Table 3. Estimate of balance of wastes deposited in the lagoons.

Lagoons	Area (m ²)	Average thickness of asphalts (m)	Volume of vacuum residues deposited in the lagoon (m ³)
1	3,500	0.4	1,400
2	6,000	0.3	1,800
3	7,700	0.5	3,850
4	4,400	0.5	2,200
5	2,900	1.0	2,900
6	1,200	1.0	1,200
TOTAL	25,700	-	13,350

CONCLUSIONS

Contamination of the area of the former oil refinery has been identified in a larger part of the premises of the former refinery, which is, together with associated plots of land, currently in possession of the Town of Kuçovë (NISHANI, 2004; URBÁNEK & BARTOŇ, 2009; URBÁNEK & POLENKOVA, 2010).

The main hot spot of contamination is represented by the lagoons nos. 1 to 6 containing wastes from oil processing, i.e. asphalts, tars and coking residues. The amount of Waste and Waste products are (area and volume) estimated on the basis of three methods: topographic survey; geophysical survey and digging holes and drilling of wells without rallied.

The total amount of waste dumped in the lagoons no. 1 to 6 on a surface of about 25,700 m² can be estimated at 13,350 m³, while the total volume of produced waste is estimated >2 083 100 m³ (Table 3).

This is a unique case study for the pollution level in Albania, emphasizing contamination and the impact on the environment as mentioned above (Plates I, II).

Table 3. Balance of the total volume of produced waste.

Lagoon no.	Type of deposited waste	Area of the lagoon (m ²)	Average thickness of deposited waste (m)	Volume of waste deposited in the lagoons (m ³)	Total volume of waste deposited in lagoons (m ³)	Estimate of the volume of produced waste (m ³)
1	Asphalts	3,500	0.4	1,400	3,200	2077000
2		6,000	0.3	1,800		
3	Tars	7,700	0.5	3,850	6,050	6100
4		4,400	0.5	2,200		
5	Coke-oven residues	2,900	1.0	2,900	4,100	It is not estimate
6		1,200	1.0	1,200		
TOTAL		25,700	-	13,350	13,350	>2 083 100

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Lalaj Nensi, Prifti Irakli

Polytechnic University of Albania
Faculty of Geology and Mining, Department of Earth Sciences
Rruga e Elbasanit, Tiranë, Republic of Albania.
E-mail: nensimehmetilalaj@gmail.com

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PLATE I



Photo 1. Oil refinery during 1965 (original).



Photo 2. Lagoon no. 3 (original).

PLATE II



Photo 3. Lagoon no. 2 (original).



Photo 4. High level of toxicity on lagoon no. 2 (urban waste) (original).



Photo 5. Lagoons no. 4, 5, 6 (original).



Photo 6. An urban trash container in a polluted area (original).