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STUDIES ON POLLUTION MADE BY THE INDUSTRIAL WASTE DUMPS

BY

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Abstract. This study presents the method of monitoring the dumps of wastes resulting from the iron and steel industry and their impact on the environment. The case study carried out at a metallurgical group of enterprises emphasizes the negative impact of the waste dumps on the environment. The monitoring was performed on the following fields: the wastes storage in the environment, the operation of the dump, the impact on the environment etc. The analysis carried out referred to the dumps running and the ones in conservation. The present paper analyzes also the new regulations regarding the environmental agents monitoring and the ecologic reconstruction of the area.

Keywords: dump; industrial waste; monitoring; environment; ecologic reconstruction.

1. Introduction

Pollution is a process by which the biotic and non-biotic environments are altered but which affects also the values created by the human society being caused by human activities. Furthermore, contamination may also involve an environmental degradation caused by natural agents. One of the 13 domains

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regulated by the environmental IQ is represented by the vast and complex domain of "waste management" which comprises specific regulations regarding industrial waste dumps:

Industrial waste dumps must be endowed with control and measurement equipment in order to measure the parameters considered in the analysis. The behavior in time of the running dump should be monitored following the new regulations adopted in the field. Due to the high construction, operation and monitoring costs of a controlled waste dump both during its filling and during its conservation, a cost - profit analysis is expedient. This analysis will represent a criterion in selecting the storage area and the construction solution of the dump. According to the provisions in force in the European Union the storage prices should cover the closure, operation and monitoring costs for a period of minimum 50 years after the dumps closure.

2. Pollution Induced by the Industrial Waste Dumps

Important quantities of waste more or less toxic, depending on their nature which cause big problems in what regards their processing and storage, result from the industrial processes carried out within the S.C. ARCELOR MITTAL S.A., Galați. Their valorization was performed periodically, the useful substances being recovered and used for other purposes. In many cases these wastes were deposited in inadequate conditions, without previously preparing the ground; the wind and rains often transported these wastes to large areas and infested the underground waters and the surface waters, the environment being thus seriously damaged.

The slag dump analysed is located in the Western side of the metallurgical group of enterprises and neighbors Mălina Bog to the North and the exploitation road of Sendreni Mayoralty to the East. The location of the dump starts at an altitude of 10.00 m on a table land situated between Cătuşa and Mălina Valleys and the farm lands of the localities Smardan and Movileni.

The dump occupies a surface of approx. 110 ha. The average height of the dump is of approx. 50 m. The height varies surface-wise depending on the dump exploitation degree. In some sectors of the dump holes were formed due to the slag exploitation. The surrounding land, situated outside the perimeter approved for storage is partially and even totally covered with wastes.

The dump, which is situated in the Western part of the unit, first occupied the Eastern side of Mălina Lake and advanced towards other directions covered with water. The advance was horizontal, but also with a continuous slope and if in the beginning the elevation marks were 40…46 m height they reached 60 m in the unloading faces area.

The construction of the slag dump started in 1968. The wastes resulting from the technological process of the Metallurgical Group of Enterprises Galați (Fig. 1) were stored there.

The execution project based on which the waste dump was built is no longer available.

Fig. 1 – The industrial waste dump in operation phase.

The analysis carried out within the dump for 5 years pointed out the following risk situations:

a) there is no natural or artificial waterproofing;

b) the waste dump has no drainage system for the leachate collection and treatment;

c) there are no collecting channels for meteoric water;

d) the waste dump has no gas collection and disposal system;

e) the dump slopes are instable;

f) meteoric waters infiltrated into the dump are not collected and drained through an appropriate drainage system;

g) the subsurface waters are polluted by uncontrolled infiltrations from the waste dump;

h) the access in the dump is free, etc.

The metallurgical group's operation is in direct relation with the evacuation and storage of the wastes. Due to the quality parameters but also from technical-economical reasons the wastes cannot be revaluated.

The wastes have been stored there for a lot of time and this is why a relief currently called slag dump appeared next to the unit.

36. 0 mil. tones of blast furnace slag and approx. 14. 0 mil tones of steel plant slag were deposited on the slag dump location during the 1968,…,2006 years. They were stored on the surface of the dump on a more or less selective basis. Initially the surface of the deposit was smaller but by successive deposits the actual surface exceeded the designed one. Despite this, there have not been taken neither waterproofing measures for the extended base of the dump nor measures meant to ensure the leachate draining and disposal system.

3 mil. tones of blast furnace slag, 1.50 mil. tones of steel plant slag and 600,000 tones of other wastes have been deposited in the dump during

2003,…,2006 years. An estimated share of the stockpiled materials is shown below:

a) blast furnace slag – approx. 47%;
b) steel plant slag – approx. 30%;
c) refractory wastes and other – approx. 23%.

The volumetric density of stockpiled material has an average of approx. 2,100 kg/m^3.

The industrial wastes dump and the technological processes carried out on site do not generate residual waters. The used water resulting from the slag granulation is collected by the sewage system of the metallurgical group.

The meteoric waters infiltrating into the material stored infiltrate into the soil too where from they get into the ground water and then into the emissary (Mălina Bog). At the same time the waters draining on the dump slope determine its erosion, whereupon they draw off into Mălina Bog. Part of this water is absorbed by the mass of the dump or by the soil in the adjacent area. The infiltrated water influences the quality of the subsurface water and of the water in Mălina Bog.

Mălina Sud sludge bed situated in the Southern part of the dump, helps the used waters from the blast furnace and steel plant slag taken over by C8 collector discharge in Mălina Bog.

Since there is no draining and collecting system of the leachate generated by the percolation of the dump by the meteoric waters, the slag dump through its position influences both the quality of the subsurface water and the emissary (Mălina Bog).

Because the storage and distribution surface of the industrial wastes has exceeded the Western bounds of the dump, the escarpment of the dump registered some landslips between 2004 and 2005. This phenomenon generated silting processes and even the obstructing of the sewer in Mălina Nord area.

In order to deposit the wastes in the slag bank the automotive transport is used for the blast furnace and steel plant slag. In order to deposit the refractory and industrial wastes, the railway transport is used. The blast furnace non-granulated slag, cooled and solidified is transported and deposited in the slag dump on platforms, a new stage being thus created the access being possible on the previously deposited wastes.

The truck unloading face is situated in the NW side, on the marginal line of the slope. The bank slope is consolidated only by the compaction exercised by the trucks weight. The waste trucks are side-tracked, blocked and then dumped. When the slope has achieved its back angle and the wastes no longer slip towards the base, a dozer compaction is performed and the infrastructure towards the area of the new slope is prepared (Fig. 2).

The infrastructure of the new unloading railway face is made of various types of wastes with different granulations. This procedure is adopted because the effect of the slope upon loading is unknown and slide surfaces may appear. It is worth mentioning that in the access area where the wastes transport is done

by railway, the storage was not selective. Various types of materials and wastes are met in this area.

Presently the wastes storage is done on a surface of 84 ha, with the recommendation that the present limit of the dump should be observed.

The waste storage dumps are hydrotechnical constructive structures which involve some special technical – economical and social aspects, such as:

a) ensuring the stability and preventing the possible accidents which may take place by the industrial wastes displacement as well as by their forming structure breaking;

b) collecting the surface and subsurface waters with their treatment where necessary;

c) preventing the contamination of the environment with substances carried off from the dumps;

d) the reintegration of the land used for deposits into the economic and ecologic circuit.

Fig. 2 – Unloading face for the industrial wastes.

The existent legislation on which governs the design, the operation and closure (abandon or conservation) of the dumps (waste bank) is very vast, the most important being:

a) GUO 244/2000 amended and completed with the Law 466/2001 regarding the safety of the dams;

b) 426/2001 Law for the approval of the Government Urgent Ordinance no. 78/2000, regarding waste regime;

c) the Order of the Minister of Waters and Environment Protection no. 1147/2002 for the approval of the Technical Standard Regarding Wastes Storage – the construction, running, monitoring and closure of the waste dumps;

d) 867/2002 – the Order of the Minister of Waters and Environment Protection regarding the definition of the criteria that wastes must fulfill in order to appear on the national list of accepted wastes from each class of waste dumps;

e) 162/2002 – The Decision of the Government regarding the wastes storage.

The existent environment legislation regarding the construction, monitoring and closure of the waste dumps, includes specific recommendations regarding the necessary data and information for each stage of the dump life cycle.

3. Results of the Environment Agents Monitoring

The technological monitoring is carried out during the entire operation duration of the dump and is essential for its good running. Thus the risk of accidents and destruction of the waterproofing bed is reduced. The working order of all the dump components should be permanently controlled: the access road and the one in the precincts, the condition of the existent endowments, the degree of settlement and the stability of the dump, the control of the waste entrances (consignment notes, making the conformity analyses), etc. (Fig. 3 and 4).

Fig. 3 – The pollution of the Mălina Valley.

For a strict supervision of the wastes bank running the strict monitoring of the liquid, gas and solid emissions is necessary. Its object is to check if the emissions comply with the competent authorities' requirements (the environment authorization, the water utilization authorization).

The monitoring process of the subsurface waters is carried out for the following parameters: pH, suspensions, fixed residue, CCOCr, chlorides,

sulphates, nitrates, ammonium, Fe, Ca, Mg, phenols, cyanides, Cr, Zn, Mn, Pb, Ni. Each month samples are taken from the observation drillings executed on the site and in the neighborhood. The samples are analysed and the results are compared with the values imposed by the existent standards and norms.

Fig. 4 – The industrial waste dump in operation phase.

In order to monitor the underground water, two drillings executed down to the depth of 21.0 m are used.

The quality of the environmental agents from the influence area of the wastes dump is controlled having in view:

a) the registration of the meteorological data obtained from the local weather station on a monthly basis in order to establish the quantity of precipitations, the temperature and the prevailing direction of the wind;

b) determining the concentrations of the specific markers in the environmental air from the dump influence area (sedimentation powders – monthly, aerosols – monthly samples);

c) determining the noise level during the operations which require blasting and during the wastes unloading and ecologyzation works (two quarterly determinations);

d) determining the specific concentration of pollutants in the soil from the dump influence area (pH, SO_4, Cd, Mn, Pb; four samples taken from the four cardinal points per semester).

Due to the nature of the wastes and the storage technology used, the material which makes the structure of the slag dump is very inhomogeneous both physically and chemically. On the other hand, the dump has impressive dimensions both in horizontal and vertical plane. Therefore, a characterization of its physical chemical composition by lab analyses would take a lot of time and the conclusions would be irrelevant and uncertain. Consequently, it seemed expedient to take samples from the material stored, the wastes being characterized by the analyses performed by the producer.

The soil samples were taken from the neighboring area next to the bank from 4 points (two samples for every one: a surface one and one 30 cm deep) situated approximately on the four cardinal directions in respect to the dump. The dump position as well as the predominant wind direction in the area was considered. The choice of the four sampling points allows the analysis of the polluting effect of the dump activity on the soil.

Considering the nature and the chemical composition of the wastes deposited and the recommendations in annex 3.1 to the MAPPM Order 184/1997, the lab analysis of the soil samples aimed to determine the heavy metals (Pb, Cd and Mn), sulphates and pH concentration.

In order to value the wastes dump contamination effect, the results of the analyses performed on the soil samples taken from the East side of the location in June July 2006 are presented in Table 1.

Table 1

Contamination Effect of the Wastes Dump

Soil sample code	Determined parameters				
	pH	Cd mg/kg	Mn mg/kg	Pb mg/kg	SO_4^{2-} mg/kg
Less sensitive possessions (inside the metallurgical unit)					
E/ (surface)	8.18	1.42	1,370	53.2	460.2
E / (30 cm)	8.20	1.58	1,399	46.7	880.2
Normal values (Ord. 756/1997)	-	1	900	20	-
Alert threshold (Ord. 756/1997)	-	5	2,000	250	5,000
Intervention threshold (Ord. 756/1997)	-	10	4,000	1,000	50,000
Less sensitive possessions (outside the metallurgical unit)					
E/ (surface)	8.26	1.61	1,270	38.2	601.4
E / (30 cm)	8.22	1.83	1,184	37.5	909.8
Normal values (Ord. 756/1997)	-	1	900	20	-
Alert threshold (Ord. 756/1997)	-	3	1,500	50	2,000
Intervention threshold (Ord. 756/1997)	-	5	2,500	100	10,000

From the analysis of the data results that the soil samples have a pH value of over 8, 0, what confers to the soil in the area an alkaline character. The concentration of the lead in all the analysed samples exceeds the normal values without exceeding however the intervention threshold for the sensitive utilities.

Considering the position of the sampling points with respect to the slag dump and the predominant direction of the wind the negative effect of its activity on the soil is obvious.

Presently S.C. MITTAL STEEL S.A. manages selectively the slag wastes. Distinct areas for wastes storage were arranged. In the following period the utmost utilization of the wastes will be achieved by the excavation and processing of the slag in the dump, without affecting

however the stability and safety of the dump. The wastes which cannot be valuated shall be stored in a distinct area in a controlled and selective manner, according to the technology.

During 2005…2006 year the granulation of the blast furnace slag was done up to more than 70% of the slag quantity produced so that no slag would be stored in the dump.

4. The Post Closure Monitoring and the Ecologic Reconstruction

In order to comply with the environment protection requirements regarding the closure of the slag dump, the following measures should be taken:

a) the final coverage of the dump under safety conditions considering the previous land utility and the landscape framing;

b) monitoring the emissions into the environment after the actual closure of the dump for minimum 4 years until the complete stabilization of the wastes.

The layers of the covering system must ensure

a) the stabilization of the wastes;

b) the subsequent use of the land;

c) waterproofing layer;

d) layer for collecting and disposing the rain waters;

e) vegetal soil layer.

According to the legal provisions, the dump operator is obliged to ensure the post-closure monitoring for the period established by the competent environment authority (min. 3 years). The post-closure monitoring system shall be performed for 4 years and shall comprise the meteorological data, the concentrations of pollutants in the soil, underground water and air, together with a careful monitoring of the subsurface water quality parameters. At the same time, topographical studies on the stability of the slag dump shall be performed by using the landmarks mounted on the dump platform and on the slope.

After turning to good account part of the slag dump, ecologization technologies shall be applied for the volume remained unvalued after extracting the iron. The works include putting back the slag dump into the forest circuit and shall be done by stages.

The ecological reconstruction of the wastes dump shall be considered completed based on some evaluation criteria regarding

a) the quality of the environment agents;

b) the wastes settling;

c) Possibilities of subsequently using the ecologically rebuilt land.

The subsequent use of the location shall be done considering the specific conditions and restrictions imposed by the existence of the covered dump depending on the stability of the land and the degree of risk it may present for the environment and human health.

5. Conclusions

1. In order to make the industrial waste dumps safe the regulations in the field correlated with the European law provisions shall be observed.

2. The slag dumps resulting from the metallurgical and syderurgical groups require special attention due to the components included. They influence significantly the stability and circulation of the surface and subsurface waters.

3. The dump safing must be carried out during the operation stage by adopting measures meant to allow a controlled expansion and super elevation of the dump but without affecting and polluting the environment of the location. The research carried out in this case study indicates various contamination stages of the surface and subsurface waters.

4. During the operation and conservation stage the permanent monitoring of the parameters specific to the dump as well as of the location environment should be performed in order to reduce to a minimum the environmental contamination.

5. Both during the dump operation and conservation stage the location area should undergo an ecologyzation.

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STUDII PRIVIND POLUAREA DIN HALDELE DE DEŞEURI INDUSTRIALE

(Rezumat)

Acest studiu prezintă metoda de monitorizare a haldelor de deşeuri rezultate din industria siderurgică şi impactul acestora asupra mediului. Studiul de caz a fost efectuat la un grup metalurgic de întreprinderi si subliniază impactul negativ al haldelor asupra mediului înconjurător. Monitorizarea a fost realizată pe următoarele domenii: depozitarea deşeurilor în mediul înconjurător, exploatarea haldei, impactul asupra mediului etc. Analiza efectuată face referire la haldele ce sunt in funcţionare şi cele în conservare. Lucrarea de faţă analizează de asemenea, noile reglementări privind monitorizarea agenţilor de mediu şi reconstrucţia ecologică a zonei.