ARCELOR MITTAL'S INDUSTRIAL WASTE MANAGEMENT

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Abstract: Over the past four decades the largest slag dump in the country has been formed near the town Galati, belonging to Arcelor Mittal Integrated Steel Galati. The deposit, regarded as a mountain of waste materials, can become a useful source of construction materials, replacing natural materials by using a modern technology. Until then it is still an element with a particular impact on the environment through changes in the landscape, visual discomfort, air, surface water and groundwater pollution, soil fertility changes and changing in the composition of neighboring biocoenoses and of course, a negative social impact. Measures to avoid, or decrease the effects are related either to greening the slag dump, provided by law to begin in 2014, and ecological models that have proved reliable in other EU countries can be taken over, or to exploitation of the slag and its conversion into construction material for roads, highways, dams, successfully replacing natural materials - rocks for construction

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As a member of the EU our country must adopt an environmental policy regarding the waste management. Their valorization through recovery and recycling is not only an obligation but a national necessity and an economic and environmental priority.

In recent years, the cooperation of all economic branches and their development in a closed system of matter and energy transformation (circular flow economy) is absolutely necessary due to the concept of sustainable development. In the current circumstances, recycling seems to reintroduce a maximum of two thirds of the waste into the production flow, the remaining one third forming waste from other waste.

Going to Tecuci, at 5 km from the town of Galati, run down the right side, about 3 km of road, a huge slag heap can be seen as a true mountain near Lower Siret Plain. Perhaps many of us ask questions about its role and whether it affects the surrounding area. The only source of information about this landfill is the press, which is more or less objective, and presents this landfill in the newspapers, quite often as a true threat to surrounding inhabitants. Scientific information is difficult to obtain and people who are asked often have divergent opinions. Most consider it a true eco-bomb, just like everything related to the steel mill. A natural question could be: is this the only dump in the world and there are no solutions to change its appearance? And if so - what are these solutions?

Landfill – an anthropic form of relief.

The landfill, regarded as consisting of non-hazardous deposits, is located in the major riverbed of Malina, supported by the western terrace top (or plateau Smârdan) where Arcelor Mittal Integrated Steel Galati is located. Its beginnings are linked to the first industrial production of steel and other ferrous products, established in 1968.

Administratively, the waste landfill is located in the outskirts of the villages Sendreni and Movileni, Sendreni near Galati. Its location was chosen mainly because of the vicinity with the great steel mill and of the necessity of a nearby place for dumping the high volume of transported material. The east terrace near Lake Catusa was too close to the city, so there were only two possible locations. The dominant wind direction from north-eastern area would limit the quantities of dust transported from the landfill to the city, and thus in a sheltered space because of Malina's major riverbed terraces reaching 20m in height.

Figure 1 Landfill – satellite images (google search engine)

It occupies an area of 84 ha (but the area affected by the landfill is 110.87 hectares (including the space occupied by adjacent communication paths or park machinery) occupying the second place at the national level (after the ponds at Soda Govora), both having the shape of a fan pointing to the east, to the top of the terrace, from where its development started, occupying almost all of Malina's major riverbed, which now appears to be next to a cannel leading from the Sendreni terrace, having a trapezoidal shape, with a slope angle of 26-27°. The actual height at which it is found is about 51m above sea level, having relative heights of 42.2m and a weight of more than 57 million tons. The current volume is estimated to exceed 26 million m3, and consists of blast furnace slag, steel mill slag and complex technologic waste.

In the north of the heap, tailings ponds are located in the form of collectors, separated by dams, and farther to the north rests the North Malina Lake, a fishing area that extends up to the village of Smardan. In its south, three other dammed enclosures can be found, the largest one having a role in settling water and the other two being fish enclosures - all being part of the South Malina Lake. From here, the water is thus directed

toward the Siret River through a cannel that passes under the road which was built on the lido that initially anastomosed river Malina (being a fluvial haven in origin).

Figure 2 Landfill – in 1989 (left) and 2010 (right)

Environmental impact

Generally, due to lack of facilities and poor exploitation of landfills, waste deposits are accounted for the impact and risk generators of the environment and public health.
The main types of impact and risk caused by industrial waste landfill, in the order they are received by the public are:
- changes in the landscape and visual discomfort;
air pollution;
- pollution of surface and groundwater;
- changes in soil fertility and composition biocoenoses on the surrounding fields;
- social impact.

Figure 3 Landfill – environmental impact

Changing the landscape is clear. Mountains of slag, even if they are hidden in the major riverbed, are visible from the road, with the lunar aspect, being covered with vegetation. Dark grey colour, dust, wind swept landscape give a special look to the plain covered with steppe vegetation. Being looked at closer, the current dump heap is the field of slope processes which further degrades the overall picture: dripping and torrential

processes occur, anthropic excavation which favour collapses, mudslides and landslides-collapses, and inside the waste dump the settling processes develop.

Air pollution by wind-blown suspension is particularly evident in the current industrial deposits, in which cells operation and cover with inert materials are not practised. Taking into account the geographic area in which the landfill is under the influence of a climate with shades of aridity and wind of about 88% frequency, the fine particles that create the waste dump are easy to carry, especially during summer , when dryness favours more their dislocation. Thus, the particles are carried away by the wind from the north to the villages Sendreni and Movileni and further south to the localities from Braila county, the one in the south (in summer) will affect the air quality in Smardan. The movement of solid particles to the west will be brought to the city of Galati. This dust is deposited in surrounding areas, many of them, agriculturally cultivated, form a thick layer at the surface of the leaves, thus, limiting photosynthesis, indirectly the green plants growth and less agricultural productivity. For Galati city, the waste dump and the traffic are the main sources of dust.

The leakages *from the deposits on the slopes* situated near the surface waters contribute to their pollution with chemicals and suspensions. The most serious side effects related to the slag heap on the environment are those that are directed to water, both for surface (Malina, Siret, Danube) and groundwater.

On Malina River there are two lakes with the role of combined sludge settling. The waste dump is located between the two lakes, practically blocking the natural course of Malina, which between the two lakes, North Malina and South Malina appears as a linking canal. The threat is linked to the likelihood of landslides that could obstruct partially or totally that channel. Such a slide occurred in the summer of 2009, when a portion of tens of thousands of tons of landfill collapsed and crossed over Malina river for more than 300 m. have been affected Both the basins of lake dam downstream North Malina and the sewage system from South Malina were affected. An initial negative effect was related to the pollution over acceptable limits of settling basins, their clogging and the danger of sudden evacuation to Siret. A second problem was related to rising water levels in the settling basins with more than 3.5 m above the water level of the upstream lake, additional forces being exerted on the dam and the marginal embankments. The effects had been disastruous, because they could have produced a flood of polluted waters to Sendreni, affecting both the Siret and Danube water quality and the road Galati - Tecuci. The problem was solved partly by excavating material slid into the canal, but the danger is permanent because the dump slopes are sustained in this canal.

Such accidents could be avoided if clogging should be more frequent, but the pace is very slow, with a single machine, the costs being covered by recycling clogging materials that contain a lot of iron. The The extending of these clogging basins is not possible as they are limited by the lake North Malina and the waste dump (north and south) and the side terraces. Only the surface decrease of the dump would leave room for new basins. Collectors pond are surrounded by earth embankments, bare: collector 6 (for suspensions), the collector 7 (30% slurry with Fe, Al, Pb, Zn), the collector 8 (pollutants in the table) and collector 9 (sludge with oxides Fe, Al, magnesite, phenol, cyanide). Indirectly, these waters pollute the groundwater (wells) and Siret water quality.

Biopedologic changes are obvious on long term. Natural or economic sealing of land for landfills is a process that can be regarded as temporary, but in terms of "sustainable development", it extends over at least two generations if planning periods are added together (1 - 3 years), operation (40 years), rehabilitation and post-monitoring (at least 15-20 years).

In terms of biodiversity, in theory, a landfill is the elimination of the affected area that uses a total of 30-300 species / ha (110 ha X arise between 3300-33000), without considering the soil microbiological population.

Specifically, the waste dump removed the natural vegetation from at least 110 ha, plus the characteristic fauna. There is a clear cut difference, visible between the areas situated in the north and south of the dam, which closes the lake North Malina. Towards the lake, the vegetation is developed, being represented by rush and reed, a special area for many species of birds (wild ducks, herons) and fish, and in the basins fish are excluded , and the reed, is rare stunted and yellow to due to water acidity.

Although the effects on flora and fauna are theoretically limited in time during the exploitation of the landfill, environmental reconstruction done after the release of its technological area will not initially be able to restore the biological balance, the evolution of the bio-system being irreversibly changed. Waste, especially the industrial ones, represent a health risk because of their toxic substances such as heavy metals (lead, cadmium) and radioactive substances, pesticides, solvents, oils.

We could also mention the social effects caused by the illegal exploitation of the slag heap by the people from the neighbouring villages -Sendreni and Movileni. Its content, rich in iron, has attracted people from the surrounding villages. In time, they passed from 'artisanal mining ", i.e. that of a disadvantaged population seeking scrap for survival to a" mining industry ", a real „rush for iron", with true clans who got enriched in the two villages where there are more than 60 voles and other operating machinery. Even if there is specialized guard, this phenomenon may be limited, and there is a duplicity of the industrial giant because outside Movileni village, there are at least 10 scrap collection centres, run by the steel mill platform, where thieves can exploit the "found" iron.

Measures of ecological recovery could be grouped into legislative, technological and natural or organic.

The measures used to avoid or decrease the effects are related either to greening the heap, provided by law to begin in 2014 or of exploitation of the slag and its transformation into construction material for roads, highways, dams, successfully replacing natural materials - construction rocks.

The steel mill representatives support the exploitation and transformation of the slag into construction material; currently there are three companies that have appropriate technology. It is estimated that about 5,000 tons of slag are produced daily, and trains with 6-8 wagons unload it every hour. These wastes are either furnace slag or steel mill slag and are thrown on a front of about 150m long and 6-8m height, with a temperature of 13,000 C, in the form of mounds called "cakes". The newly formed front is watered for two to three days so that the temperature falls to 100-150°C, slowly disintegrating itself. The resulting slag is taken to a warehouse where it is watered again, so that the

mechanical connections are lost, and the calcium oxide dissolves, which, if not eliminated, would lead to cracks in the roads it will be used for. After six months the slag is swung into a bunker where it is processed, and a material called lidonite is created. This material can successfully replace natural stone. During this process, sand, crushed stone, and rubble are also obtained, and the steel is sold back to the steel mill at moderate prices (one eighth of the market). About 100,000 tons of Lidonite are produced each day and the landfill area is reduced. This scenario would be even more successful if the transformed volume would be higher, knowing that by 2014 we would not be able to use but a small part of the landfill, and the European directives require closing the current dump and the greening of the area at the specified date. As many experts say, the time required for processing most of the landfill would be until year 2021 (annually, only 500,000 tons are processed, instead of 12 million tons as it would be optimal).

A strange problem is related to the law in Romania, which allows the use of natural stone building material, knowing that the EU permit the grinding of the mountains by exploiting stone quarries, only after the highway manufacturer receives a denial from a slag processor, providing he does not have enough lidonite in stock. Examples from Europe show the importance of slag in construction, seeing that even the embankments of the Rhine are covered with boulders of slag. The positive effects are related to a decrease in size of the mountain, the affected area getting so much smaller, thus easier to green. Also, new jobs are created in the lidonite exploitation domain. The costs aren't very high, and could be covered by the other expenses that occur unless lidonite is capitalized: 70% from the reduction in transport costs, 20% from the recovered material (iron and steel, aluminium) and 10% from the reduction in landfill charges.

A second way of limiting the negative environmental effects is related to greening the dump, but until now there was no clear project. At the European level, there are models like Kiruna (Sweden) and Rhur - Saar (Germany).

If the Swedish model is used, the dump would be brought to heights of 15 m, on the terraces, the final result being two or three terraces, the upper being inside the dump, this way increasing stability (three terraces are necessary for the slag dump in question - with a height of 42 m). The ecological reconstruction work is based on replanting terraces, adding soil and seeding vegetation and the edges of terraces would be stabilized with small berms of rock. The planted area should be watered early in the early stages of reconstruction. As the waste rocks can slide from the top of the center to the periphery of the dump, the surface can be spread with coarse dry sterile and then soil, (up to a thickness of about 20 cm) and organic fertilizer. Trees and shrubs can also be planted for this area; in this case it may be the acacias, adapted to the dry steppe environment.

The purpose of recultivation:

- improving the balance of water consumption (infiltration and surface drainage);
- improving the visual impact;
- increasing the habitat for flora and fauna;
- improving the biodiversity of the area;

The terraces would be much smaller (0.5-4m) if the the Rhur - Saar model is adopted and the compaction could be done by rolling truck tires or with vibrating rollers, to reduce oxygen penetration or precipitation in the dump's body as much as possible. An exterior wall would be built and immediately re-vegetated; it will serve as a shield for

subsequent deposits. The advantage of this model is that it would merge the operation of greening the dump with the exploitation of the slag as a building material. The dump would not be completely closed, just like in the first case but the surface would be greatly expanded.

Conclusions

This study highlights the dump, which shouldn't be seen just as a constant source of pollution, because, it can be transformed into a source of raw materials by some legislative measures, at least for the area Galati - Braila, situated in a plain, away from the natural building rocks (except Macin, but there is no optimal way of communication) or it can be successfully rehabilitated by using European models, both aimed of decreasing negative environmental impacts, a light at the end of the tunnel for the largest dump in the country. Even if, legally, there are similarities between the Romanian legislation and those of The European Union, in reality, there are big differences. A simple calculation can estimate that from the 77% of the dump used for construction (the furnace and the steel mills) it can be recovered at least two thirds of the volume and 50% of the dump, finally resulting a half area occupied then currently, and thus more easily to rehabilitate.
In a future that may be closer we could talk about a true ecosystem steel, with less effect on the environment.

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