ENVIRONMENTAL IMPACT OF BROWN FIELDS SITES IN HUNEDOARA AREA

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Abstract: *By national economic restructuring process and global economic business climate, most of the steel production capacities from Romania have been closed and completely disaffected. To clean up the polluted areas related of this disaffected production units, is a huge work has been made and shall be made taking into account the high degree of soil contamination with various type of pollutants, since 1884 when the first blast furnaces were put in operation. The evolution of former Hunedoara steel plant after restructuring and privatization is presented in this paper, and also is presented an environmental impact of brownfields sites results from disaffected of this production unit. It will also make a review of waste deposited on the company land and also proposals for reinstatement in economic circuit.*

Keywords: *environmental impact, disaffected production unit, greening industrial site*

1. INTRODUCTION

Hunedoara city covers an area of 9743 hectares, being located in the center of the county, near the confluence of Cerna and Zlasti creek at the eastern foothills of Poiana Rusca Mountains. Attested at 1265 under the name Hungnod according to papal title registry, Hunedoara will know an impetuous development and will play an important role in Romanian history. The age of this settlement is far deeper into in the mist of time, than the documents who talk about it, [4]. The archaeologists have found both in the precincts of the city and also in the neighborhood villages, traces of habitation dating back to the stone age, but also a steel workshop consisting from eight furnaces dating from the Dacian age.

Hunedoara city was "the factory town", one factory town, respectively the CSH Hunedoara town. The town was one of the predecessors of the "socialist industrialization" process; the outlining of the town is earlier to the period of communist industrialization.

The Iron factory from Hunedoara is the result of the technical and technological development from the Austro-Hungarian Empire, from the end of the nineteenth century, due to the development of production and acute needs of steel, generated by military campaigns conducted by the state.

The occurrence of the steel factory from Hunedoara was required by market expansion due to increasing the consumption of metal in mechanic workshop and mechanical engineering factories from Transylvania.

In the 50`s the steel industry was a top industry, its development was also influenced by the reconstruction effort during that time in Europe. Do not forget that at the foundation of present European Union Community it was the ECSC - European Coal and Steel Community.

CSH Hunedoara integrated iron and steel plant was started, in 1938, with German technology. During the expansion of the factory between 1953 and 1958 there have been built production capacities (with soviet technology that in these years was very similar to western technology, mainly due to the American help during the war).

2. PRODUCTION FACILITIES

Hunedoara iron and steel plant construction began in August 1882, and it was officially opened on June 12, 1884; this date marks the appearance of the iron factories in Hunedoara. In the local Gazette, no 25 from June, it is recorded: "Blessing and good luck Hunedoara! The first melting charge of iron already flowed, the Ghelari hill melts at Hunedoara", [4].

Fig. 1 Iron and steel plant from Hunedoara, at the beginning of the past century

One year later, on May 24, 1885, the second blast furnace is put into operation. With this, the center of weight of siderurgical industries from Transylvania is moved to Hunedoara. The administration of the factory is also transferred; the former workshops (blacksmith, forging and mechanical workshops) gradually lose their importance, except for the workshop and blast furnace from Govăjdia, that is mentioned in documents as being in service until 1918. After 1920 the Iron and Steel plant from Hunedoara were presented as a mining-steel complex, who owned a significant operating fund formed from: iron ore mining in surrounding area; 5 blast furnaces with production of 119,000 tone/ year; an iron foundry workshop with production of 1,500 tone/year; a forging workshop with 2 steam hammer forging; a mechanic workshop for processing the molded or forged components with production of 500 to 600 tone/year; a workshop for manufacturing the bricks for furnaces; limestone mining some charcoal pile; one high blast furnaces with iron foundry at Govăjdia; 400 hp hydroelectric power plant; a funicular network for iron ore [4].

After the industrialization period, CSH Hunedoara was the most important Romanian manufacturer of long profiles. The workflow was integrated and included the production of raw materials, iron and steel production unit and various rolling mill capacities:

- blast furnaces (no 5, 6, 7, 8, 9);
- electric steel plant OE 1 (0.15 million ton/ year production) with two 50 ton and two 20 ton EAF furnaces and VAD-VOD refining equipment and REZ installation;
- electric steel plant OE 2 (0.4 million ton/year production) with two 100 ton EAF furnaces and ladle refining equipment, 100 ton EBT furnaces and continuous casting machine;
- Siemens Martin steelworks no 1 with five 100 ton furnaces (0.33 million to/year production) and heavy section rolling mill 800mm;
- Siemens Martin steelworks no 2 has a production capacity of 3.2 million ton of steel per year
- rolling mill production unit with small section rolling mill (0.44 million ton/year), heavy section profile (0.113 million ton/year) and hot rolled wire (0.28 million ton/year).

3. DECOMMISSIONING AND GREENING THE BROWNFIELDS

After 1989, the transition and adjustment to the requirements of a competitive market have placed the Romanian steel production companies into an unfavorable economic environment, having as a main effect reducing, stopping and dismantling of production capacity. The economic environment of the`90 years in Hunedoara was dependent on the concept of factory town attributed to Hunedoara, from the years of socialism construction.

Fig. 2 Former Siderurgica Hunedoara - panoramic view

In 1992, the operation at the Siemens Martin steelworks no 1 was stopped, as well as some production capacities from primary production flow.

In July 1999, the operation at Siemens Martin steelworks no 2 is stopped also, fatality or coincidence was that it was stopped on June 12, 1999 (the date they would have had the 115th anniversary of starting the new factory). This certified the final and irreversible stopping the primary production flow (coke plant – in May, sinter plant – in June, blast furnaces – in June which was the last iron melting charge at Siderurgica Hunedoara).

Gradually they closed production unit from OE1, OE2, rolling mills production unit, power station 1 and 2 that partially produced hot water and heat for the city, and many other production facilities and workshops which ensured maintenances of the production facilities.

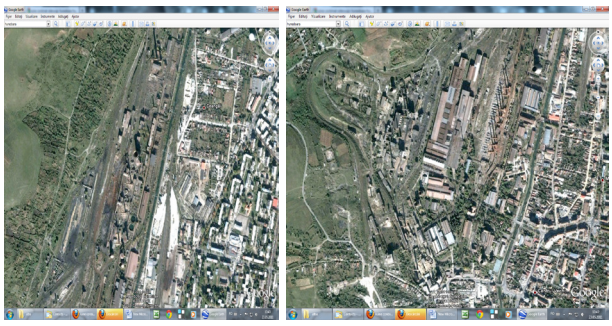

Fig. 3 Disaffected area of steel plant - view

Sinter plant, blast furnaces, raw material plant is presented left and coke plant, steel furnaces plant, rolling mill are in right.

At present, the former integrated iron and steel plant works with 100 tone EBT furnaces, a continuous casting machine and one rolling mills production unit.

The economic impact of restructuring has had a devastating effect on the city and its surrounding areas. So, in 1997 the steel plant had a number of 15,296 employees, from which 85.5% workers, 3.4% foremen and 11.1% office staff, and now the unit has less than 700 employees.

Due to this transformation, a huge area of over 220 hectares resulted, with industrial ruins (buildings and disaffected installation), on the territory of former primary workflow, raw material warehouses, rolling mills facility.

This area must be rehabilitated and reintroduced into the economic cycle, [1,2,3,5].

In the area where the steel plant has developed, a historic pollution of environmental factors is present, due to the heavy metals and hydrocarbons from coke, sinter and steel furnaces disaffected unit. It can be said that the area represents one of the largest industrial facilities with ruins from Romania, called Brown field.

These fields should be fully decontaminated and rehabilitated, after that it must be done an urban infrastructure in order to be capable for a new urban feature integrated into the future concept of the city. Rehabilitation will be done by applying the concept of sustainable development.

Disposal of equipment, installations and technology production space has been made in the first phase by the owner; this focusing especially on the recovery of scrap metal and other metallic materials existing in their structure. To continue the greening of the area, the possession has been ceded to the city council, who founded a company that works at present at the greening of the area [6], using even European funds.

So, for example, on the surface of coke oven batteries, coal transport and store area, surface on coke discharging, coal bunker, and so on, the total quantity of the disposed nonmetallic and metallic waste was around 100,000 m^3.

Fig. 4 Former coke plant

In the coke plant area, most of the demolished constructions were metallic (chemical tanks, transport pipes, pumps, etc. but also networks and power stations), the amount of concrete and bricks was around of 43,000 m^3.

Almost 140 hectares of the surface are held by the assets of the former coke plant and steel plant.

Fig. 5 Former sinter plant

In the area of blast furnaces and the sinter plant, most of the demolished constructions were mechanical and electrical equipment, the total quantities of nonmetallic waste it was over 74,000 m^3 .

For the greening of Hunedoara industrial site and its preparation for new activities, there have been made several studies related to polluted areas of the steel plant, [6].

Thus, these projects propose greening of the surfaces in two phases:

- rehabilitation of the polluted site, when the contaminated areas will be identified, specific pollutants for each area, respectively proposals for remediation of soil and groundwater;
- preparing the rehabilitated site for new activities, when there will be made buildings, utilities, derivations and branch pipes in order of production and service activities.

Fig. 6 Former blast furnaces

Based on the activities performed in this area, of the specific technological processes and of the preliminary study, it can be told relative to pollution of the environmental factors that:

- for the soil environmental factor, there have been recorded sensitive changes in soil surface and depth, due to the presence of heavy metals (Pb, Cd, Fe, Cu, Zn, Mn, Cr, Ni) in concentrations below the limit of intervention for less sensitive soil. Adjacent areas have not registered significant influences, the values determined being under the limit of intervention for less sensitive soil (Fe in the old city area and Mn in the pre-village Răcăştie area, where it worked since the year 1884 – area of old blast furnaces).

Fig. 7 Former steelworks OSM 2

- for the environmental factor, in the area of coke plant, in the underground water there have been detected ammonium and heavy metals (Pb, Fe, Mn), etc.

The company that manages the greening of contaminated zone works on a 2010 study conducted by a specialized company, identifying the real values of the pollution degree in affected areas.

Soil from the area of the former Siemens-Martin furnaces, blast furnaces, sinter line and storage area (iron ore, coke and limestone) present a significant degree of contamination with heavy metals, especially Mn, Zn, Pb.

In literature it is recommended decontamination methods which involve the storage of soils contaminated with metals in inert waste disposal, in locations that do not allow groundwater contamination.

In these cases, storage of soil contaminated with heavy metals, stripped from existing locations and in inert waste disposal requires the next steps:
- excavation of contaminated soil on the depth recommended by the consultant;
- charging and transportation in the place which will isolate it;
- smoothing, compacting and waterproofing;
- closing inert waste disposal so established;
- cover with a layer of clay and its compactness, adding vegetation layer;
- monitoring of inert waste disposal (post-closing).

Fig. 8 Former coke-chemical plants area, contaminated soil before rehabilitation works

At the site of the former coke-chemical plants it has revealed sulfur content in the groundwater beyond the limits required by the standards, due to historical pollution and contamination with hydrocarbon of 0 - 1.5 m depth in the area of former pumping stations and reservoirs of coal tar.

Also in area of coking plants were inventoried approximately 9,000m^3 volume of soil contaminated with coal tar and significant amounts of brickwork also contaminated with coal tar.

In this case there can be used the thermal rehabilitation (incineration) of hazardous waste, or disposal at the waste disposal area after a technology similar to neutralization of soil contaminated with heavy metals.

Liquid coal tar waste is recommended to be neutralized in hazardous waste incinerators or they can be used like alternative fuel if possible.

Fig. 9 Former coke-chemical plants area after rehabilitation works

Waste from demolition can be valued by selling bricks, the scrap of bricks or concrete waste are used for filling of underground dumps resulted from excavations of contaminated soils.

Fig. 10 Area of former iron and steel plant after demolitions of buildings

The demolition of the buildings can be done both through the conventional methods (such as dynamiting) and through unconventional methods in order to protect historical monuments in the area, especially Hunyad Castle.

4. CONCLUSIONS

Diminishing of the activities and closures of production capacity has a major negative economic impact over the region economy, the economy of region is not recovered until now because of the lack of major investments in the area.

The company had a very hard restructuring process, the number of workers decreasing from 15,296 employees in 1997, to a total of 685 employees according to a 2012 report card.

As far as the types of waste generated by the process of greening of former industrial sites are concerned, we can conclude the following:

- coal tar waste and other petroleum products must be neutralized through burning in specializes facilities, or they can be used as alternative fuel;
- soils and concrete (brick scrap) contaminated with coal tar results from demolition will be recommended to be stored in deposits especially established for hazardous waste according to the current regulations;
- soils contaminated with heavy metals are recommended to be stored in special deposits for hazardous waste;
- concrete and bricks waste is recommended to be used (after crushing) to filling the underground dumps resulting from the excavations of the contaminated soil .

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