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Improvement of Environmental Situation Caused by the Consequences of Steelmaking in Albania

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Abstract
This report seeks to evidence the environmental situation caused by the consequences of steelmaking processes in Steel Plant, Albania, in order to show its improvement over the years until today. Improvement of environmental indicators consists in reducing environmental pollution from mass of dust in emitted gases during steelmaking; at reducing content of the gas components released into the atmosphere such as: COx, NOx, SOx, and generally the reduction of energy consumption. This is achieved due to the installation of several advanced techniques in the Plant of Metallurgical Combine, "KURUM International", in Elbasan. The results presented in this report are divided in the form of data according to the environmental indicators measured in years, according to the lines and advanced techniques installed at the plant. Details of the environmental indicators/parameters are determined by means of known monitoring methods. The Report compares the environmental pollution from the steelmaking before and after the application of advanced techniques, which result in optimal quality parameters of emitted gases, referred to National and International Legislation Norms.

1. Introduction

Steelmaking industry in Albania is located in Plants of Metallurgical Combine "KURUM International". The main objective was the production of steel, mainly in the field of construction products, using scrap as raw material. At the international level, the technological requirements for quality of steelmaking were increased, requiring the application of modern technologies, but with high demands in terms of environmental protection and health of the population from its environmental pollution [1, 2, 3, 4 and 5].

Our previous paper identified the environmental pollution indicators caused by steelmaking consequences and treated the application of some advanced techniques for enhancing the quality of steel and especially to improve the environmental situation [1]. While this report takes into account the environmental indicators in years, by comparing them with the allowed International Norms [2, 3] and National Legislation [4, 5].

Advanced techniques and their process parameters are analyzed on the basis of monitoring results [6, 7], mainly in the definition of an essential environmental indicator, *the mass of dust in gases emitted per a ton of produced steel billet* in the Continuous Casting process, because this indicator has been the most problematic one of environmental pollution in the region.

Details of the environmental indicators / parameters are determined by means of

monitoring methods and instruments of specialized structures of the country [6, 7].

2. Improving of Environmental Indicators from Application of Advanced Techniques in Steelmaking Plants

Production of steel is a process associated with a major environmental impact [2 and 8], air: emissions of dust, particullate matter, oxides and metals; water: organic content, oils, metals, gas phenols, acids, sulfides, sulfates, ammonia, cyanide, etc.; soil: solid waste, refractary brick residue, slag, sludge, sulfur compounds, heavy metals, oils and grease residue, salts.

Initially, Institute of Metallurgy and KURUM company [6], with the help of monitoring process, identified the main consequences of environmental pollution during the production of steel [1] and this is the reason of installation of these lines:

2.1. Installation of Dust Collection System with Bag Filter for Off Gases in EAF (Electric Arc Furnace)

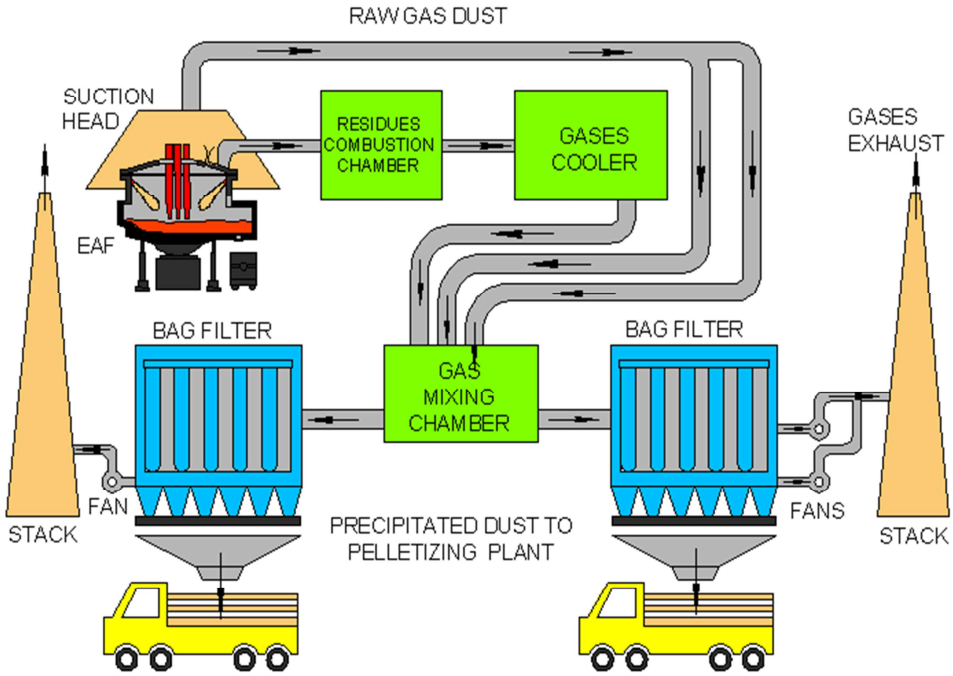

Figure 1. *Technological Schema of the line for dust collection from off gases.*

Table 1. *Amount of dust in off gases, mg/m³ [6, 7, 8 and 9].*

In years	Dust Stack 1	Dust Stack 2	Norm
2004	80	-	100
2005	60	-	100
2006	65	120	100
2007	70	130	100
2008	75	135	100
2009	65	52	75
2010	55	35	75
2011	70	45	75
2012	36	33	75
2013	50	52	75
2014	45	38	75

Dust of exhausted gases from the steel electric oven is one of the significant pollutants and the most problematic in the steelmaking Plant, in Elbasan. For this reason, in the exit of the furnace, EAF has installed a system for cleaning off gases from dust as shown in Figure 1. The bag filters provided an optimum indicator of cleared gases from dust [1, 4 and 6].

It has been determined the respective efficiency in this line based on environmental monitoring that is performed by the Albanian monitoring structures for indicator of dust content during cleaning off gases, mg/m³ [6, 7]. These results are shown in the Table 1.

Installing Shredder line, which prior selects the scrap, has secured dust reduction in the load that melts in the EAF furnace, and consequently has reduced the amount of dust emitted into the atmosphere.

The data in Table 2, relate to an important indicator, that is expressed with the *'dust into the atmosphere per ton of steel produced'*.

Table 2. *Operational data of the steelmaking process and dust collection for a ton produced steel in years [6, 9 and 10].*

In years	Scrap for melting, 10^3 tone	Dust at the entrance, tone	Off gases, 10^6 m^3	Effectiveness of dust collection, %	Dust in the atmosphere, kg/tone. produced steel
2004	170	2040	200	55	6,46
2005	200	2400	250	70	4,3
2006	240	2880	300	72	4,03
2007	270	3240	340	90	1,44
2008	284	3328	400	89	1,37
2009	332	4032	6000	94,8	0,43
2010	425	5186	6400	94,5	0,87
2011	460	5228	6800	90	1,4
2012	$305e^3$	3613	$4.8e^9$	93,96	0,75
2013	$368.3e^3$	4497	$4.12e^9$	94,5	0,63
2014	$485.9e^3$	5540	$5.55e^9$	94,6	0,53

According to Table 2, Dust collection efficiency is increased to 95%, on the other hand are consolidated the environmental indicators gases discharges into the atmosphere. National norm of 'dust in atmosphere (in kg) per ton produced steel' has decreased from year to year, showing improvement in the environmental situation, but compared with EU norms, it remains high [9]. Allowed norm is 0.2 kg/ton produced steel [10].

In our opinion, one of the parameters that needs to be implemented, in addition to upgrading the readiness and maintenance of the system is the preservation of processing capacity in the furnace in function to the capacity of cleaning gases line.

2.2. Scrap Selection Line – Shredder Process

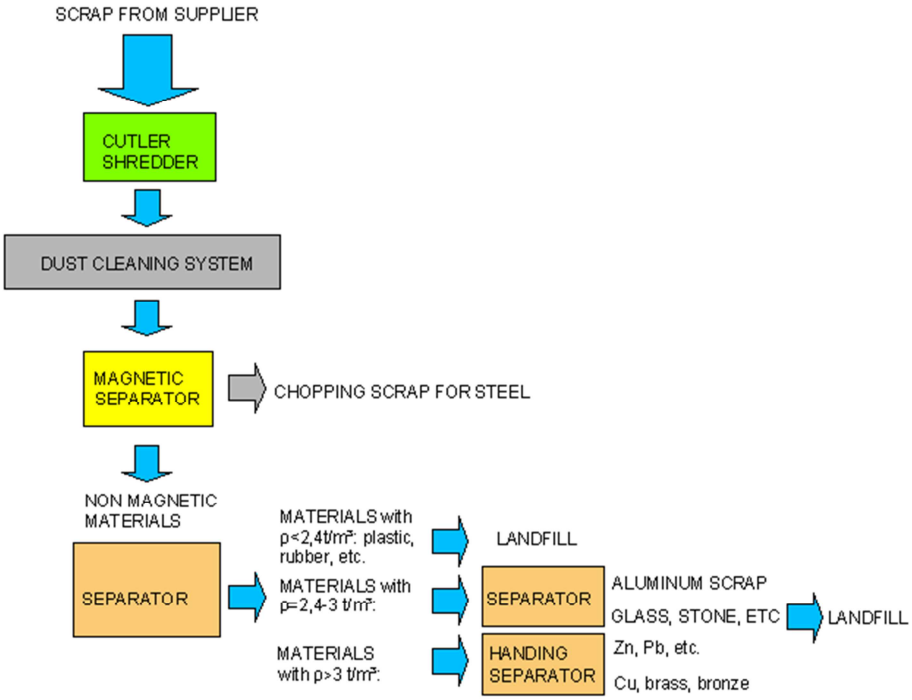

Figure 2. *Schema of Shredder Process.*

Installing Shredder line (Fig. 2), which prior selects the scrap, has secured dust reduction in the load that melts in the EAF furnace, and consequently has reduced the amount of dust emitted into the atmosphere, thus avoiding adverse effects and especially toxic effects from burning of plastics and other non-metallic materials, very harmful for health [2, 4, 6, and 8]. Its positive effects are summarize:

- Reduce the amount of plastics and other non-metal waste around 14kg/ton;
- Decrease the amount of dust in the emitted gases 0.06kg/hour;
- Increase the effectiveness of the cleaning line with 2-4%;
- Increase processing capacity;
- Decrease the amount of slag, about 7000 tone/year;
- Decrease the amount of emitted gases with 18x106 m^3/year;
- Reduction of electricity consumption used for melting in furnace, EAF, about 2.5%;

Reduce emitted pollutants together with the off gases:

- Reduced dust;
- Reduce of pollutants emitted by burning plastics, paint, grease, etc., about 80-90%, so, it's reducing the vapor of

chlorine, arsenic, Zn and Pb oxides, mercury vapor, sulfur, that are contained in plastic;

- Reduce of dust concentration in flue gases, about 50%;

Investment made in early 2012 for a pre-preparation of scrap, fragmentation, selection, etc., has positively influenced the process of melting the scrap in electric furnace, accompanied not only by cost reduction, but also improvement of the environmental impact (for previously schema) and especially the content of the gases generated / released to the atmosphere.

2.3. Lines for Processing of Slag

In terms of technological waste re-use, these last three years the company has made an improvement by building near the plant two lines for selection of electric furnace slag (black and white slag).

This provides the possibility of the benefit of the metal mass in the slag which is distributed via a partition and fractionation line, but still remains as a solution the possibility of re-use residue after this process for use in the cement industry etc.

Dust captured in the gas cleaning system of the steel plant, after packaged will be sent for export to countries in the region for use as raw materials for steel production but also for the exploitation of zinc etc.

2.4. Replacement of Solar with Liquid Petroleum Gas in Coil Sector

In the coil Sector has already been installed a line for preheating of billets in furnace, which replaces solar with Liquid Petroleum Gas, LPG (30% propane and 70% butane). Since in the second half ’13 has been done a complete replacement of solar with LPG, it has brought many positive effects on the environmental situation.

The steel billets (the party of steel billets about 60-70%) come in a hot state (in temperature about 500-700°C) for their following processing in this sector. It is worth mentioning that the second half ’14 is invested in this sector for better automatic control the quality of fuel used which has brought not only its saving but also the optimal parameters on the quality of the exhausted gases in atmosphere.

Table 3. *Values of emissions from off gases [1, 10], for last three years, when solar content is replaced with LPG content.*

Emission		Solar content (mg/m^3)	Norm (mg/m^3)	LPG content (mg/m^3)	Norm (mg/m^3)
2012	Dust	85	75	38	50
	SO_2	1672	1700	27	900
	NO_x	82	450	105	200
	CO	146	170	88	100
2013	Dust	72	75	40	50
	SO_2	1465	1700	75	900
	NO_x	12	450	130	200
	CO	72	170	72	100
2014	Dust	-	-	36	50
	SO2	-	-	12	900
	NOx	-	-	66	200
	CO	-	-	68	100

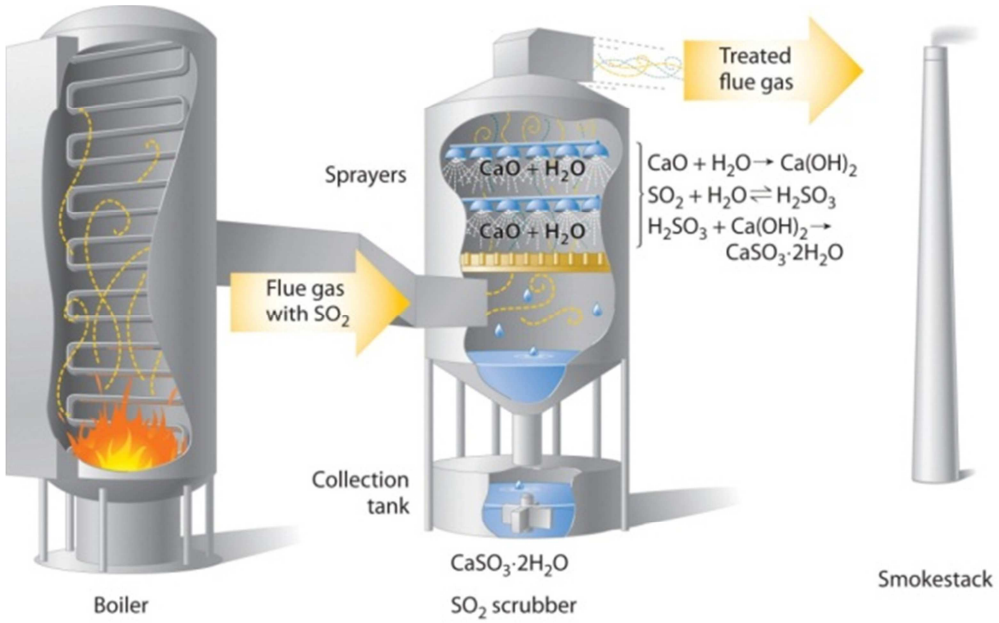

Figure 3. *This is schema of Wet Scrubber tower in Lime Manufacturing Plant.*

Some of the main improvements in the environment are mentioned in our previous paper [1].

2.5. Installation of Cleaning Gas Line in Lime Manufacturing Plant

Since in the first half '13 has been installed the wet Scrubber tower (Fig. 3), according to the Recommendations made earlier [1]. It looks so far that this investment has justified itself because it is more secure, guarantees environmental norms and it is even lower cost than the preceding schemes of Bag filters [8, 9, and 10].

This scheme provides the appropriate settings in the dust capturing of some other gases, compared with the preceding scheme (Table 4).

Table 4. *Values of emissions compared with norms.*

Emission	2012	2013	2014	Norm
Dust	58	48	42	50
SO_2	290	142	64	400
NO_x	36	45	12	1500

This process in wet Scrubber should be accompanied by correct monitoring of the discharge scheme of water waste although these waters after decantation are recycled from solid masses. It is thought that by dissolving a quantity of SO_2 has created the acid pH and may require neutralization with lime.

3. Recommendations

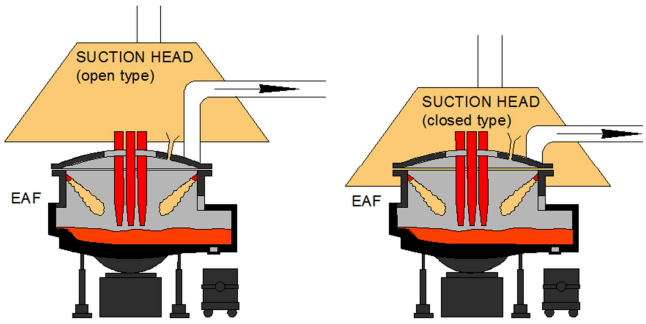

Figure 4. *Actual schema of suction head (open type, on the left) and the proposed movable type of suction head (on the right).*

Recommendations are mainly technical:

- The investment for improvement of the preparation raw material scrap scheme in the respective Shredder line type, to minimize spreading of dust in any specific node, like in the square where moving the internal transport vehicles; its discharge system of combustion gases - silencer should be vertical, not horizontal, because of the pressure in exit of its, not to cause the distribution of dust in the ground;
- To evaluated the possibility of changing the suction head (where oriented process gases) of EAF, by modifying it from the fixed (open type) in such model to be movable (up and down positions), depending of working process, to ensure encapsulation of furnace space during melting process up to casting of product. This avoids lateral scrabbling especially in the initial stages of scrap melting enabling introducing in the system the entire quantity of generated gases.
- Better synchronization of scrap processing capacity in electric arc furnace, EAF, with gases cleaning line capacity; automatically controlled cleaning of bag filters and improving its other parameters;

4. Conclusions

The main and most important conclusion is that in all environmental indicators noticed a significant improvement. The industrial level situation is improved, but with innovative suggestions can be achieved even more.

- Application of advanced techniques from "KURUM International" company aims to modernize the technology to increase the technical parameters of steel products and especially the improvement of environmental indicators, mainly reducing the amount of dust in the emitted gases. This has increased the effectiveness of dust collection.
- However the application of the lines of cleaning off gases near to EAF and scrap selection, by increasing the level of their technical readiness, *exist the possibility to reduce* a concentration of dust in off gases less than 20 mg/m^3, respectively and the amount of dust released into the air at about 0.2 kg/tone produced steel.
- *The mass of dust in gases emitted per a ton of produced steel billet* in the Continuous Casting process is an essential environmental indicator that has been the most problematic one of environmental pollution in the region. Its reducing is an objective for 2016.

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