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Minimizing Pollution Effects through Recovery of Gases Thermal Energy from the Scrap Recycling Process

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Abstract This study consists of minimizing the pollution effects of the recycling industry through the application of new duplex systems, which could be used for the purification and regeneration of the gases in smelting scrap. In the first phase, the process of recovering thermal energy from the scrap melting process will be based on creating a thermal profile and managing furnace zones, whose theoretical profile will be based on thermal analysis data. The previous preparation of the filling would be based on the data of the chemical analysis of the smelting products and process gases and the chemical and granulometric analysis of the flux and coke. In the second phase, the ratio of CO_2: CO in the process gases will be regulated, which is the most important indicator of the effectiveness of waste recycling through the scrap melting process. Industries, especially those for energy generation and recycling, due to outdated technological schemes, improper management of industrial waste resulted in a lower level of utilization of natural resources and energy and a high level of environmental pollution. According to the results of this study, minimization of environmental pollution and problems related to the efficiency of the process would be possible between the integration of gas cleaning equipment in CSC systems and/or the application of SCHACK systems. The application of this system would enable the minimization of pollution from greenhouse gases (CO, CO_2, NO_x, SO_2, etc.) and their return to the process will guarantee energy recovery and generally improved process efficiency. According to this pilot project, the gases that are released from the process of melting waste from the scrap in the cupola furnace of the "E&E" foundry are taken at a height of 3.6 m, from areas where their temperature is between 800-1000°C and through the SCHACK system they are returned in the coke burning area. Our study program is focused on the research of technological possibilities that would enable the minimization of the polluting effects of the scrap recycling industry in the cupola furnace, between gas purification from particles and dust, and their return to the process.

Keywords Recycling, SCHACK, Pollution Minimization, Recovery Energy, Efficiency

1. Introduction

The global production of cast iron, steel and other ferroalloys through scrap recycling has never played such an important role as it does now. However, world crude steel production in December 2023 for the 71 countries reporting to the World Steel Association (World Steel) was 135.7 million tons (Mt). So, there was a decrease of 5.3% compared to December 2022 [1]. Such a decline in world steel production resulted from the energy crisis and efforts to meet the objectives of the United Nations Conference on Climate Change COP26. These objectives relate to the undertaking and financing of concrete and rapid actions to keep global warming below 1.5°C [2]. Such an objective could be achieved only through technological progress, which above all has the principle of minimizing greenhouse gas emissions. So, although quite challenging, the steel industry globally has intensified actions to reduce net CO_2 and other greenhouse gas (GHG) emissions to the level of 50% or more by 2050. For example, the EU state has launched the "Ultra-Low CO_2 Steelmaking" project, in Japan, "Ultimate Reduction in Steelmaking Process by Innovative Technology for Cool Earth 50" and also a series of other initiatives, etc. [3] – [5].

Two general groups of gas-based alternate technologies for making iron have been developed: shaft furnace processes [6] and fluidized-bed processes [7] - [9]. These technologies, however, are not sufficiently intensive to compete with the blast furnace, for they cannot be operated at high temperatures because of the sticking problems.

In Kosovo, such technological progress, as well as the fulfillment of international obligations for contributions to reducing the effects of global warming, is very limited. The production of electricity from lignite, as well as the metallurgical industry, which is dominated by the production of ferronickel, and the recycling of old steel, represents the main polluters of the environment. According to data from the monitoring stations of the Hydrometeorological Institute of Kosovo [10], poor air quality is a constant problem throughout the year, but air pollution especially affects Pristina and Drenas, the cities with industrial activities in Kosovo. And Kosovo in general, pollution mostly affects during the autumn and winter seasons due to the increase in the burning of fossil fuels, the burning of lignite for energy production, and other polluting sources. In 2020, pollution peaked at a concentration of 367.2 µg/m³ of PM10, concentrations of 234.5 µg/m³ of PM2.5, concentrations of 206.5 µg/m³ of NO_2 and SO_2 levels of 294, 8 µg/m³ [10]. As a result of metallurgical activities and the poor level of management of the Fe-Ni slag dump, Drenas, and its surroundings continue to be characterized by poor air quality. At this level of pollution, gases, dust, and vapors from the processes of ore smelting, ferronickel refining, and slag water granulation, in the "Ferronickel" Smelter, have the main influence. Thus, the release of particles and fly ash of the cavity (between 30µm and 5µm in size), together with dust particles larger than less than 10 µm (PM10) or even smaller than 2.5 µm (PM2.5), which have toxicological implications and they attack the respiratory system and reduce immunity are found that most environmental organizations evaluate the waste dump as an "environmental hot spot", while Drenas is known as a city with high level of pollution [11] [12].

Based on the data from the simulations carried out at the "E&E" foundry in Gjakovo, this research is based on the concept of "Flash Ironmaking Technology (FIT)" [13], which is based on reducing iron oxide concentrates by gas in a flash reactor. In our case, the role of the reactor is played by the SCHACK system, which cleans and recovers the gases of the cupola furnace, in which coke is used as a reducing agent and fuel. So, SCHACK is a gas energy purification and regeneration system, which is similar to "FIT" reactors, but only instead of hydrogen, natural gas, or other fuels, the gases of the scrap melting process would be used for steel in the cupola furnace. The development of the new process also includes two of the most serious aspects in the production of cast iron and steel through secondary metallurgy, i.e., the reduction of carbon dioxide emissions and other greenhouse gases, as well as the reduction of energy consumption. Currently, the steel industry contributes about 6~7% of total anthropogenic carbon dioxide emissions.

The gases of the scrap melting process in the "E&E" smelter from the cupola furnace would be taken to a temperature of approximately 900°C and would be introduced into the SCHACK reactor, where they would be used as fuel for the preheating of the air that is injected through the primary blowers into the hearth of the furnace. And recirculation of dust and some of the gases were injected through the secondary blowers. Apart from the fact that such systems would enable the recovery of fumes and the purification of gases, thanks to the high energy potentials of these gases, the preheating temperature of the air could reach up to 1500 °C. Replacing the injection of cooled air with preheated air injected into the hearth of the furnace would require less fresh fuel, and CO and H_2 released as a result of the intensification of reactions in the hearth of the furnace, from the gasification processes of C_{fix} of coke and water vapor (conveyed to the batch) and other reactions, would be necessary for the development of indirect reactions in the oxidizing zone of the furnace, which would lower production costs, and make the scrap melting process in the most economical and environmentally friendly oven. These systems will also be able to be used in double processes with LD converters with oxygen blowing or/and in the electric furnace [14] [15].

The process gas in our case would be brought, a gaseous fuel that is partially oxidized with industrial oxygen to generate a reducing gas at 1600 – 1900 K. A scrap of steel is fed from the top of the furnace dome, and the reduced cast iron product can be collected as a molten bath for direct cast iron production or steelmaking. Thermal energy in such cases is formed by oxidation to the highest degree of the main components, such as; of carbon (C_{fix}) and hydrogen to CO_2 and H_2O, according to exothermic reactions, ($C + O_2 = CO_2 + Q$ and $2H + O_2 = H_2O + Q$) and the same energy according to the new SCHACK approach will be used for non-reduction and acceleration (through heating) and other endothermic reactions. The process is called "combustion", while its products are called "burnt", "process gases" and/or "flue gases", which represent the gaseous technological fuel. The quantity, composition, and caloric value of which depend on the process that takes place in the oven and on the composition of the load. The gas obtained from the smelting processes in the blast furnace during the reduction and smelting of iron ores has a high value of combustion heat, which ranges from 4000 to 8000 kJ/m^{3}n, [16] [17], values that are approximately equal to those of the gases obtained from scrap melting processes in the cupola furnace. The amount of gas that is formed during the metallurgical process in the blast furnace as well as the cupola furnace is approximately 3m3n per 1t of cast iron and is sufficient to be used as an important source of heat [18].

Our case study consists of researching the possibilities of return and recovery of the thermal energy of the gas from the scrap smelting process and using it as a fuel for the preheating of the air that is dosed in the hearth of the cupola furnace in the foundry "E&E" in Gjakovo.

2. Materials and Methods

For the preliminary preparation of the load, the theoretical profile of the process, thermic chemical, and granulometric analyses of the components of the load (scrap, coke, smelter) the data from the foundry laboratory "E&E" in Gjakovo were used. Tests of the scrap melting process in the cupola furnace were developed for the conditions when the process was developed with the injection of normal cooled air and those from a pilot operation of a SCHACK reactor (simulated in laboratory conditions). The speed of the reactions, the efficiency as well and the effectiveness of the process for both cases are taken into account based on the combination of the speed of the oxidation-reduction reactions, with the temperature, the residence time, and the partial pressure of air and gas to achieve the degree of reduction > 95%. The technological profile of the process is built based on the diagram given in Figure 1.

The control of the process is done by determining the volume, calorific value, chemical properties of the gas, as well as the chemical, physical, mechanical properties of gray cast iron, other ferroalloys, and the data are obtained in the laboratories of the Institute of Geosciences, namely the laboratories of Department of Materials and Metallurgy as well as that of FTU.

The components of the charge that were used for the production of the gray cast iron in the "E&E" foundry in Gjakovo were; waste old iron/scrap that consisted of gray cast iron from the smelting process, old cast iron and steel, semi-products returned from the process, non-ferrous cast, coke was used as a fuel and reducing agent, and $CaCO_3$ was used as a flux and in a small amount also CaF_2. While the quality for metallic materials is approved based on standard specifications for gray cast iron (ASTM A48, ASTM A74, ASTM A126, ASTM A834, etc.) ductile iron (ASTM A395, ASTM A439, ASTM A536, etc.) CGI (ASTM A842), white cast iron (ASTM A532), and other ferroalloys (ASTM A436 and ASTM A518 (ATSM standards 2023 and GPS 2023).

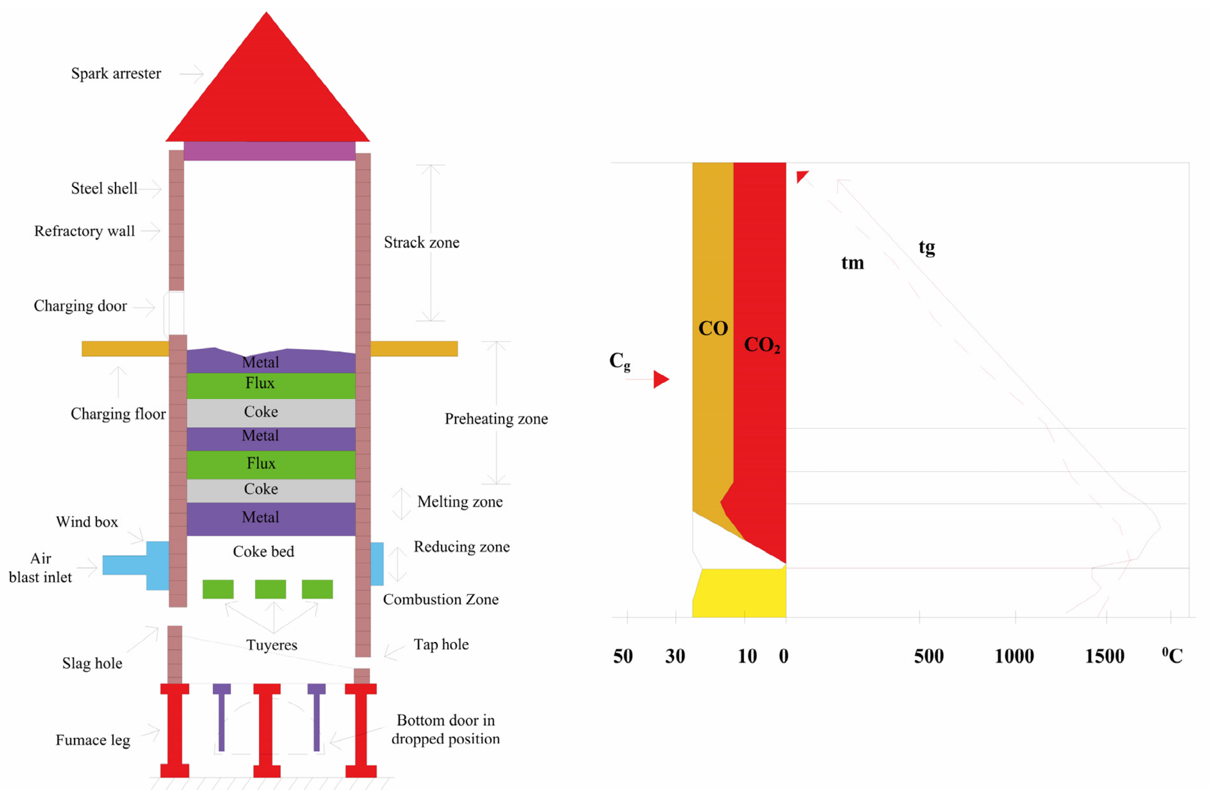

Figure 1. Areas, technological profile, areas, and heat diagram of the melting process in the cupola furnace of the "E&E" foundry (tg - gas temperature, tm - metal temperature, Cg - change of gas composition the height of the furnace)

Experimental reviews related to the research of opsins that would enable the minimization of the polluting effects of the scrap recycling industry have been developed at the "E&E" foundry in Gjakovo. The cupola furnace which is used in this small foundry in terms of construction and operating principles, is a small high furnace, with dimensions of diameter of 600 mm and effective height of 3600 mm.

Similar studies in this area, such as: "The return of gases from the smelting process, the possibility of improving the performance indicators of the technological process in the cupola furnace" were published and presented at the 24th International Conference on Innovations in Science and Technology in Milano. Treat the reduction of pollution from process gases in the dome furnace through the return of dust (after briquetting) and CO gases through blowers in the hearth of the furnace.

3. Results

To reduce emissions of greenhouse gases, dust, etc., according to the EU environmental directive, it can be equipped with an extension line that returns the gases to a device where they are cooled and solid particles are removed. Conversely, gases with thermal and reducing potential will be able to return them to the process and/or be used as fuel for air preheating for modern heat recovery systems or/and through the preheater that can be an additional part of the cupola furnace.

- Cooled air (21% oxygen, 79 nitrogen) is used to intensify the combustion process, which is blown through 4 blowers throughout the melting process.
- The furnace has; 1 hole and 1 channel for metal casting and 1 hole and 1 channel for slag.
- The components of the charge are;
  i. Waste old iron/scrap that consisting of gray cast iron from the smelting process, old cast iron and steel, semi-products returned from the process, non-ferrous cast,
  ii. $CaCO_3$, with grain size 30-50 mm (Table 1).
- An experimental examination related to the research of options that would enable the minimization of the polluting effects of the recycling industry has been developed in the "E&E" foundry in Gjakovo. For smelting scrap in this small foundry, the cupola furnace, which in terms of construction and operating principles, is a small blast furnace, with dimensions of diameter of 600 mm and effective height of 3600 mm.
- The same furnace, to reduce emissions of greenhouse gases, dust, etc., can be equipped with an extension that returns the gases into a constructive system, known as "SCHACK" (where they are cooled and solid particles are removed, while gases with thermal and reducing potentials will be able to return them to the process or/and are used as fuel for preheating the air for modern heat recovery systems or/and through the preheater which can be an additional part of the dome furnace.
- Metallurgical coke, whose chemical composition is given in Table 2, serves as a reducing agent, a burning agent, and a carbonized during the melting process.
- Composition of the metal charge is: technical iron (white and gray cast iron); steel scrap and other ferry connections (Table 3).
- According to the current approach, the average production capacity of pig iron in the "E&E" smelter is between 1500 and 2000 kg/h.

Table 1. Chemical composition of limestone ($CaCO_3$)

Composition	CaO	FeO	SiO_2	MgO	Al_2O_3	H_2O
%, weight	52.0	1.00	0.60	1.22	1.50	0.60

Table 2. Chemical composition and calorific value of metallurgical coke

Composition	C_{fix}	H_2O (wet max.)	Ash max.	S max.	P max.	Qd (calorific value), KJ/kg
%, weight	89.90	1.00-1.50	10.80	0.58	0.037	27600 - 29500

Table 3. Chemical composition and tensile strength of metal materials – scrap (Cyril et al, 2020 and ATSM stand. 2023)

Chemical composition and tensile strength of alloyed cast iron – resistance to thermal fatigue								
Type of scrap	C, %	Si, %	Mn, %	P, %	S, %	Ni, %	Cr, %	σ_mMPa
C.I[1] 4.5% C, ASTM A48	3.2 -3.6	2.2 -2.8	0.1 -0.2	0,005 - 0.04	0,005-0.02	-	-	414 -1380
Engine block	3.1-3.4	2.2-2.7	0.6 - 0.8	0.2	0.08	-	0.3-0.5	274.6
Stea. cylinder	2.8-3.1	0.9 -1.0	0.6-0.8	0.2	0.10	0.75-1.2	-	274.6
DEH[2]	3.0 - 3.2	0.9 -1.2	0.6 - 0.8	0.2	0.10	1.0 - 1.25	0.1- 0.2	274.6
BEH[3]	2.9 - 3.1	1.4 -1.6	0.8 - 1.0	0.2	0.10	1.2 - 1.50	0.5	313.8
Ductile iron	3.0 - 4.0	1.8 -2.8	0.1 - 1.0	0.01- 0.1	0.01-0.03	-	-	
A.Cu-Ni, GCI	2.6 - 3.0	1.5	0.7	0.30	0.08	14	-	230
Alloys Cu-Ni-gray cast iron	2.8 - 2.9	2.5	2.2	0.15	0.06	11	2	230
White steel, GCI pipes	0.2 - 2.5	0.3-0.8	0.2- 0.3	0.06	0.15 -0.25	-	-	193 – 700, (115- 700)
GCI, ASTM A 48 Class 40	3.25-3.5	1.8-2.3	0.5 -0.9	<=0.12	<=0.15	0.05- 0.2	0.05- 0.45	>= 276 MPa
Engine cylin. block (GCI)	2.5 - 3.8	1.1-2.8	0.4 – 1.0	0.15	0.10	-	-	– 450
Return materials	3.0 – 3.5	1.5-2.3	0.5-1.2	0.10	0.08	0.15	-	240
Lance for melting	3.0 -3.4	0.9 -1.4	0.6 – 0.8	0.2	0.1	1.25 -2.0	0.4 - 0.8	230
Exhaust pipes	3.2-3.4	1.8-2.1	0.7-0.8	0.2	0.10	1.2-1.8	0.4-0.7	210-230
Furnace parts up to 850^{0}C	2.4-2.5	5	0.5-0.6	0.4-0.5	0.1	-	-	120-140
Furnace parts up to 800^{0}C	1.7-2.0	5-6	0.7-0.8	0.05	0.06	16-20	1.8-3.0	0.10

Table 4. Average chemical composition and calorific value of mixed gas

	CO, %	CO_2, %	C_2H_4, %	H_2, %	CH_4, %	N_2, %	Lower caloric value, kJ/m^3
Coarse/thick coke[4]	27.6	4.8	/	7.5	2.0	58.6	4980
Granular coke	27.5	3.4	/	8.5	/	60.6	4375

[1] Cast Iron
[2] Diesel Engine Head
[3] Block Engine Head
[4] Grain size from 10 to 12 cm

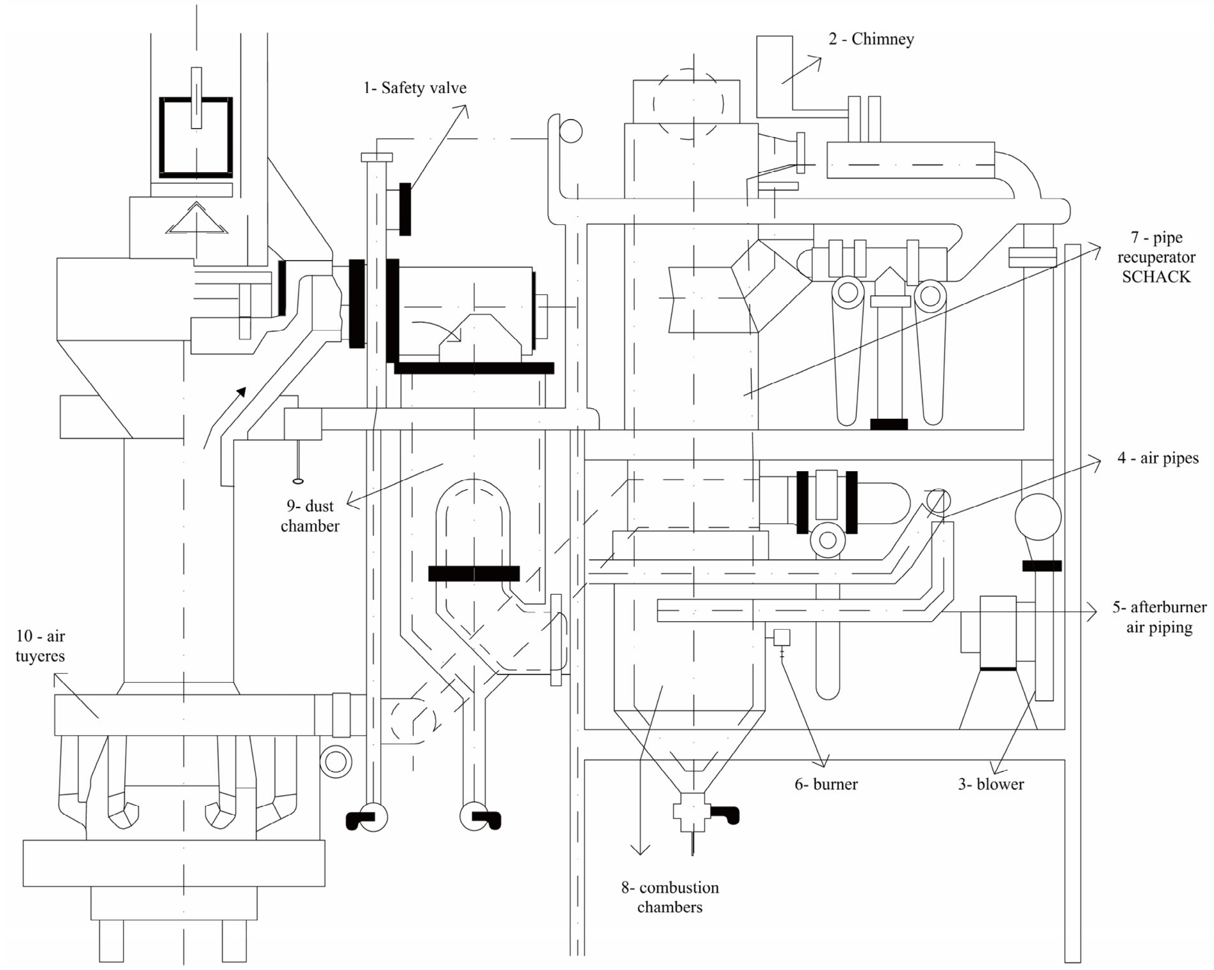

Figure 2. Heated air cupola furnace, construction SCHAC

If during coke gasification (in the coke layer) the injected air also contains water vapor, then a mixed gas is formed (as can be seen in table 4), according to the reactions (1) and (2):

$$C + H_2O = CO + H_2 \quad (1)$$

$$C + 2H_2O = CO_2 + 2H_2 \quad (2)$$

While above the grate, (where there is a large amount of oxygen entering with the air), the carbon is oxidized directly to carbon dioxide, a reaction known as the complete combustion reaction (equation 3):

$$C + O_2 \rightarrow CO_2 + 34074\ kJ/kg \quad (3)$$

In the optimal operating conditions of the dome furnace, the gas generated in the combustion zone, after passing through the path of all five zones, could be returned to the SCHACK construction (figure 2), which is one of the subsequent treatment systems and recovery of thermal energy of the dome furnace gas.

The recycling industry in Kosovo is still at a low level of development. In addition to being unprofitable, they are also irresponsible towards the environment. Exploitation concepts based on outdated technical-technological schemes, as well as the lack of a strategy related to integrated waste management and valorization of intermediate products of industrial processes, made Pristina and Drenas, as two industrial cities of Kosovo, stand out for their high level of pollution. This kind of industrial practice, in addition to the impact on the environment, also conditions the rational use of raw materials and energy sources and has resulted in poor indicators of the success of production processes. Assuming that the scrap melting process in the cupola furnace in the "E&E" foundry will be carried out according to standard requirements, related to the preliminary preparation of the charge and judging that the optimal conditions of the melting process have been reached in the combustion zone (bed of coke). During the injection of normal cooled air, in addition to the release of CO_2 in certain quantities and conditions, H_2 and CO will also be released, which could be used for the intensification of exothermic reactions, to reduce the consumption of coke and other technological materials during the melting process. Whereas, in the upper parts of the oxidation zone (IV), the amount of oxygen in the process gases decreases as a result of its consumption for coke oxidation according to reactions (4) and (5).

$$C + CO_2 = 2CO + 0.24\ MJ \quad (4)$$

$$2CO + O_2 = 2CO_2 + 0.57\ MJ \quad (5)$$

$$2C_K + O_2 = 2CO \quad \Delta H = -\ 9741 KJ/kg\ C \quad (6)$$

The temperature of the gases increases in the upper part of the tuyere and then decreases at the bottom of the furnace hearth due to the development of the reaction (5). At the end of the oxidation zone (IV), the amount of oxygen is practically zero. According to gas analysis, near the end of the blowing zone, the percentage of CO_2 will decrease, and the concentration of CO will increase, but in this case, the temperature of the zone will also decrease as a result of the endothermic reaction (7), which is known as the gasification reaction.

$$CO_2 + C \Leftrightarrow 2CO - 7700\ kJ/m^3n \quad (7)$$

Approximately at the end of the combustion chamber, there is no more oxygen and the CO_2 content is low, while the gas will have nitrogen (58 to 60%), a small amount of hydrogen (1.5 to 2.5%), and CO (31 to 41%).

$$H_2O_{(g)} + CO \rightarrow H_2 + CO_2, \Delta H = -\ 41324\ KJ/kg\ mol \quad (8)$$

$$H_2O_{(g)} + C \rightarrow H_2 + CO, \Delta H = 124475\ KJ/kg\ mol \quad (9)$$

To increase the efficiency and reduce gas pollution of the scrap (waste iron) melting process in the cupola furnace of the "E&E" foundry, a pilot process was developed based on a constructive system equipped with a recuperator and combined air and flue chambers - SCHACK that works continuously and recirculating system recirculating. The gases released by the scrap (waste iron) melting process are taken at a height of 3.6 m, that is, from zones I and II of the cupola furnaces, whose temperature ranges from 800 to 1000ºC, and are recirculated through the SCHACK system, which is a combined preheating system and enriching the air that is introduced through the tuyere into the hearth of the cupola furnace and serves to intensify indirect reactions as well as to reduce the consumption of coke as a fuel and reducing agent, as well as $CaCO_3$ or CaO which is used as a flux, which is used during the melting process.

During the exothermic reaction (4 and 5) in the upper zone of the furnace, so much heat is released that it is sufficient to heat the charge layers (in zones IV to I) to a temperature of about 1200ºC, where the development of reactions indirect is also very pronounced. However, since CO reacts with CO_2 at a temperature of 1000ºC, reaction 6 will take the direction of an endothermic reaction, i.e., creating conditions for the generation of CO necessary for the cycle of reactions indirect, i.e. reducing the chain of direct reactions in favor of indirect reactions, which express direct effects on the efficiency and effectiveness of the furnace.

Judged according to our economic and environmental analysis, the option proposed in this study would be the best technological and commercial solution for the industrial waste recycling industry, especially for scrap melting in cupola furnaces that are currently used in small foundries. This analysis shows that the main factors that affect the protection of the environment and the economy of the process are: the minimization of the volume of greenhouse gases and the lower net cost of production, which would be realized through the application of the duplex system, i.e. of return and recovery of the energy of the process gases, as well as the creation of technological conditions for the integration of CCS systems (systems for the capture and storage of CO_2).

The study "Iron Melting Cupola Furnace for Small Foundry" is a problem related to a large number of polluting gases (CO_2, CO, SOx, and NOx), but also process dust is foreseen through the enrichment of air with oxygen. The minimization of pollution, similar to our research, is seen through the reduction of CO_2 and sulfur in the molten metal. "Oxygen enrichment of the jet air is used for two main reasons, to increase the melting rate or to increase the tap temperature. Other reasons for oxygen enrichment include coke reduction and tap sulfur reduction" [19].

While, according to the study "Design, Construction, and Testing of Coal Erythrophleum Suaveolens Dome Furnace for the Foundry Industry in Nigeria", "... to improve the efficiency of the furnace, due attention was paid to the design of the tuyeres and oxygen enrichment was also introduced. According to the project, an air volume of 0.0585 m^3/s supplied to a cupola furnace with an available volumetric capacity of 0.0613 m^3 at a rate of 2652.34 W/m^2 produced an estimated heat of fusion of 255891.1 kJ/h with a melting rate of 355 kg /h for Erythrophleum Suaveolens coal which was estimated to be 326208.264 kJ/h with a melting rate of 432 kg/h for Erythrophleum Suaveolens Oxygenated Coal and it is obvious that the melting speed in the furnace was not at the designed value of 466 kg/h, for which incomplete combustion could be responsible [20].

The study, General Vision for Reducing Energy Consumption and CO_2 Emissions from the Steel Industry, indicates that “The available waste is estimated to be 1400 Mt in 2050, which is quite in line with the World Steel Association's estimate - 1300 Mt. Both of these estimates support the forecast that the proportion of waste will rise to the level of 50% by 2050. This is extremely important in relation to the issue of CO_2 emissions". This goal could only be achieved if environmental issues as well as effective production costs are taken into account. The recycling industry, such as the foundry in our study, can achieve these goals set by the Intergovernmental Panel on Climate Change (IPCC) report, which defined the goal of limiting global warming to 1.5ºC by 2050, then and there. When starting with the changes according to our proposal, this approach would be considered a partial modification of the technological scheme as well as a transitional phase of the transition to technologies that would enable "zero CO_2 emissions"[21].

4. Conclusions

The application of "new approaches" to recovery and although the steel industry, and especially the secondary-recycling metallurgy, globally has intensified actions to reduce net CO_2 and other greenhouse gas (GHG) emissions to the level of 50% or more by 2050, the industry metallurgy, especially that of Kosovo, is still at a low level of development. Being based on outdated exploitative concepts, in addition to being unprofitable, at the same time, after the thermal plants of KEK SA, and the ferronickel production industry, it continues to be in the group of the highest polluters.

Promotion of similar projects; "FIT", "Ultra-Low CO_2 Steelmaking" and "Ultimate Reduction in Steelmaking Process by Innovative Technology for Cool Earth 50", launched in EU countries, Japan, USA, etc. also in the case of the industry in Kosovo, apart from the fact that it would constitute a special contribution to the fulfillment of the obligations arising from the COP26/international conference on global warming, at the same time it would result in high effects in terms of rational use of natural resources and energy, reduction (reduction of pollution at the source) / environmental protection, and economic development.

Based on the theoretical data, those extracted from this study, as well as guaranteeing that the scrap melting process in the cupola furnace at the "E&E" foundry will be developed according to "Flash Ironmaking Technology (FIT)" practices, whereas fuel will use the gas of the melting process, the standard requirements for the environment, as well as the standard requirements [22], related to the quality of the ingredients and the preliminary preparation of the charge, then the installation of the SCHACK system would be suitable from a technical point of view - technologically and commercially.

Such a system could serve as a transitional phase and as a technical prerequisite for the installation of CCS systems, as final pollution minimization options, where CO_2 emissions would be zero.

The fulfillment of the obligations derived from the EU directives on environmental pollution and international obligations on the prevention of global warming, for countries in transition, such as the case of Kosovo, is easier and soon could be developed for the so-called "intermediate technical solutions" similar to the "FIT" approaches or the one proposed in this "SCHAK" study.

The minimization of pollution between the approaches according to the new SCHACK constructive approach, in addition to reducing environmental pollution from the process gases of the metallurgical industry, at the same time would also serve as a first step towards the transition to a new industrial regime and transformation of the metallurgical industry and not only. In addition, the regeneration and recovery of process gases and dusts, through this approach, will:

- reduce the volume of dust particles, gases, CO_2, NO_x, SO_x, and other greenhouse gases.
- low consumption of coke, which is used as a fuel for the production of pig iron through the recycling of scrap by up to 40% compared to the current process of melting scrap in the cupola furnace at the foundry "E&E" in Gjakova and reduce CO_2 emissions up to over 40%.
- increase production capacity in foundries,
- minimize mechanical losses of metals with color and/or other forms,
- improve the quality of cast iron and create opportunities for the expansion of final products;
- use the thermal potential of gas that would enable efficient use of energy resources,
- enable sustainable economic development.

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