

ENVIRONMENTAL PROTECTION IN THE AREAS OF THE DOLOMITE AND LIME PLANTS

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ABSTRACT

The environmental protection and the ecology's problems in the area of the dolomite and lime producer plants, can be solved completely, only if the pulverous materials, which result in the cleaning installation, are given back to the economical circuit. In other cases, the store of these pulverous materials in the regional ponds can cause the earth and water contamination.

In this paper we presented some research and their experimental results obtained by the researching collective (professors and engineers), in the processing of these wastes, together with hematite type ironstone (25% wastes and 75% hematite) through a pelletising operation. The resulted pellets represent an excellent addition material, from the refining slag make up, at the steel elaboration. This aspect is very important for us - specialists in the steel elaboration. Also, this procedure can be significant for the environmental protection.

Because in the vicinity of the dolomite and lime plants there are habitual surpasses of the sedimentable powder concentration, it is necessary a sufficient catching at the source. In this way is avoided the pollution of the air and the earth contamination, through dispersion on the extended areas. In this paper is showed the present situation of the dolomite and lime plants areas at Siderurgica Company - Hunedoara, where the concentration of these fine and sedimentable powders surpasses considerably the maximal admitted value ($17 \text{ g/m}^3 \text{ day} - 1,7$ times the admitted value). Also, these concentrations are much bigger in the case of evacuated gases (20 times the admitted value). Finally, the influence of the area pollution upon the life condition is presented.

1. INTRODUCTION

The concentration of residual powders in the area nearly the dolomite and lime factory in Hunedoara is 1,7 times higher than the maximal concentration allowed (17 g/m^3 per day), while on emission the concentration in the waste gas is 18...27 times higher than the maximal concentration allowed, which is 50 mg/m^3 . This situation generates a

series of problems concerning the life-conditions of the population in the affected area, concerning the risk of falling ill of the respiratory tubes, but also the deterioration of the environment through sedimentation on the vegetation, soil and constructions. In the affected zone, frequent visibility decrease and atmosphere nebulous increase is to be noticed.

For the compounding of the acid and neutral oxides in basic slag, limestone or lime is used. In the lime dissolving process it is very important to hinder the calcium ortho-silicate skin formation around the lime particles.

This is possible only if the slag contains at least 20% FeO. This means the fastening of solution formation in the FeO-MnO-CaO system, and that is possible if the lime contains more FeO. That is not possible in the lime production, but can be put into practice by producing some complex materials with a positive effect both on de-phosphorization and de-sulphurization. According to the available data in the literature produced on this subject, the most convenient means is the utilisation of briquettes or pellets with 70% CaO, 20% Fe₂O₃ and other components. Briquettes of other origin can be used, too, thus experimenting pellet producing from pulverous materials, such as: lime, steel plant dust, spathic iron concentrate, agglomerating and blast furnace residue, pellets that can be used as addition to melting slag, respectively to refinery slag.

The dominant pollution agent in lime and limestone factories is constituted by solid particles. The powder (dust) that is generated comes from finely divided particles in the limestone, from thermal and mechanical degradation of the lime and of the limestone in the furnace. The generating level of the dust varies extremely, especially depending on the type of furnace that is used. It varies between 500...5000 mg/Nm³, which corresponds to a specific emission of 2...20 kg per tone of lime. Due to the large area of concentrations in emission, a great variety of plants are used for dust removal, including dust separators, wet scrubbers, filters with textile-web and electrostatic precipitators.

After dust removal, the specific area of emission varies between 30...200 mg/Nm³, representing 0,1...0,8 kg per tone of lime.

2. EXPERIMENTS, RESULTS AND DISCUSSIONS

The experiments were made with the equipments in the iron laboratories of the Faculty in Hunedoara, namely: pulsating screen, mixing drum, chilean mill, pelletising plant.

TABLE 1. THE CHEMICAL COMPOSITION OF THE WASTES, [%]

Components for recipes	CaO	SiO ₂	FeO	Fe ₂ O ₃	Fe	Al ₂ O ₃	MgO	MnO	S	P	C
Spathic Iron Concentrate	20.2	19.8	8.9	15.6	17.9	3.16	7.56	2.29	0.1	0.3	-
Iron residue	8.4	8.4	7.1	26.4	24	7.10	2.0	0.70	0.1	1.1	17.7
Steel plant dust	0.4	1.2	1.5	88.2	14.5	0.20	0.20	4.40	0.2	0.3	-
Lime	96.3	0.8	-	0.5	1.1	0.45	1.20	0.20	0.1	0.2	-

The materials were sieved for a granulation under 0,5mm, having in view that the pellets will not be used for iron processing in the blast furnaces, but only as an addition to the steel plant slag. Table 1 presents the chemical composition of the pulverous ferrous wastes, which were used in pellet production.

Pellet production was experimented with a number of five recipes. Table 2 presents the composition of these recipes, while Table 3 contains the chemical composition of the pelletising mixtures, without bonding agent. Having in view that the hardening of the pellets was made at cold, the bonding agent contained 7% cement and 3% blast furnace slag. The slag was grinded at the granulation, which was imposed by the pelletising process.

TABLE 2. THE RECIPES COMPOSITION

No. recipes	Composition, [%]			
	Lime	Steel Plant Dust	Spathic Iron Concentrate	Iron Residue (blast furnace and agglomerate)
1	70	30	-	-
2	65	15	20	-
3	60	20	20	-
4	60	15	15	10
5	50	20	15	15

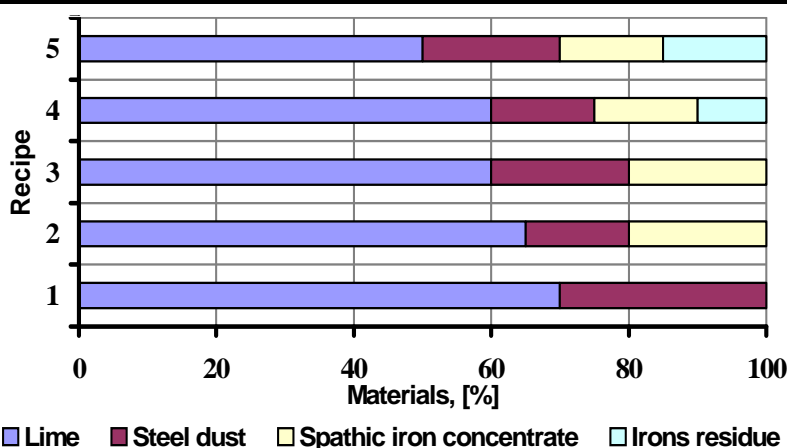


FIGURE 1. THE RECIPES COMPOSITION IN GRAPHICAL FORM

TABLE 3. THE CHEMICAL COMPOSITION OF THE PELLETISING MIXTURES

No.	CaO	SiO ₂	FeO	Fe ₂ O ₃	Fe	Al ₂ O ₃	MgO	MnO	S	P	C
R ₁	67.53	0.93	1.15	26.81	19.65	0.37	0.90	1.46	0.13	0.23	-
R ₂	66.69	0.70	2.65	16.67	13.72	0.95	2.32	1.24	0.11	0.23	-
R ₃	61.90	4.70	2.68	21.06	16.82	0.94	2.27	1.45	0.12	0.24	-
R ₄	61.71	4.47	2.86	18.51	19.53	1.48	2.08	1.19	0.11	0.31	2.67
R ₅	52.52	4.88	3.19	24.19	19.42	1.79	2.07	1.42	0.12	0.36	3.50

TABLE 4. THE PELLETISING MIXTURE (WITH A 7% CEMENT AND A 3% BLAST FURNACE SLAG ADDITION)

No.	CaO	SiO ₂	FeO	Fe ₂ O ₃	Fe	Al ₂ O ₃	MgO	MnO	S	P	C
R ₁	74.50	2.74	1.15	27.02	19.62	1.08	1.10	1.49	0.13	0.23	-
R ₂	73.66	2.51	2.65	16.88	13.72	1.66	2.52	2.52	1.27	0.11	-
R ₃	68.87	6.51	2.68	21.77	16.82	1.65	2.47	1.48	0.12	0.24	-
R ₄	68.68	6.18	2.86	18.72	19.53	2.19	2.28	1.22	0.11	0.31	2.67
R ₅	59.49	6.69	3.19	24.40	19.42	2.50	2.27	1.45	0.12	0.36	3.50

The chemical composition of the mixtures with the bonding agent addition is presented in Table 4.

The experiments were put into practice in the iron laboratories of the Faculty of Engineering in Hunedoara, using a plant with the following characteristics: the diameter of the scale - 980 mm, the height of the lateral side - 100 mm, the rotation speed - 8 rot/min, bending angle - 45° and the engine power - 1,5 kW.

The pellets were hardened by using the diagram of figure 2, to reach a compression resistance of a minimal 100daN / pellet.

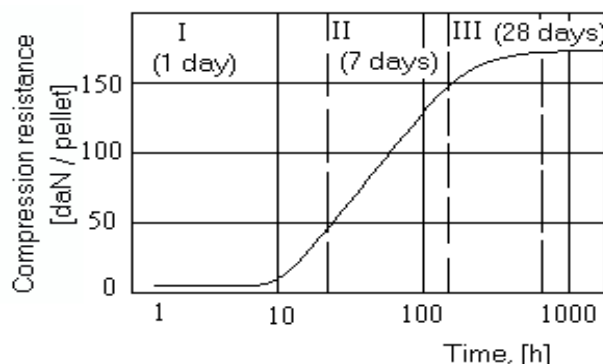


FIGURE 2. TIME VARIATION OF THE COMPRESSION RESISTANCE OF COLD HARDENED PELLETS
I – latent hardening period; II – secondary hardening period; III – final hardening period

The effect of the utilisation of the pellets, which were produced in steel processing, was experimented in an electrical steel plant, 20 tones capacity furnaces, for three charges.

At charge no. 1, considered standard charge, an addition was made with ore and lime after melting, precisely after the first steel and slag sample was taken. 0,5% ore and 0,2% lime (which represents a 150 kg ore and 60 kg de lime) was added. After 5 min., a new steel and slag sample was taken.

At charge no. 2, 0,1% of the ore was replaced with 0,3% pellets produced with recipe no.1 (R1), and the lime was reduced. A faster melting of the lime was noticed (the chemical composition of the slag is presented in table 5). At charge no. 3, 0,1% of the lime was replaced with 0,15% of the pellets, the addition being completed with 0,5% ore and 0,1% lime. In this case, the melting of the lime was better, compared with the charge no.1 (considered the standard charge), but slower than in the case of charge no. 2. The variation of the chemical composition for the three charges is presented both in analytical form (table 5) and in graphical form (figure 3).

TABLE 5. THE CHEMICAL COMPOSITION OF THE SLAGS

No. charge	The chemical composition, [%]								Basicity B=CaO/SiO ₂
	CaO	SiO ₂	MgO	Al ₂ O ₃	MnO	FeO	Fe ₂ O ₃	P ₂ O ₅	
1*	42.30	22.06	9.28	5.83	11.16	10.86	6.76	0.56	1.91
2*	45.30	21.06	8.17	4.73	8.74	12.16	7.43	0.20	2.15
3*	43.84	21.84	8.92	5.12	9.18	11.45	7.12	0.14	2.00
1**	45.16	21.17	9.32	5.83	10.82	11.93	7.13	0.40	2.13
2**	45.73	21.23	8.74	4.91	9.13	12.14	7.82	0.31	2.15
3**	45.52	22.12	9.07	5.27	10.01	11.90	7.46	0.25	2.05

* - 5 min. after the addition; ** - 10 min. after the addition

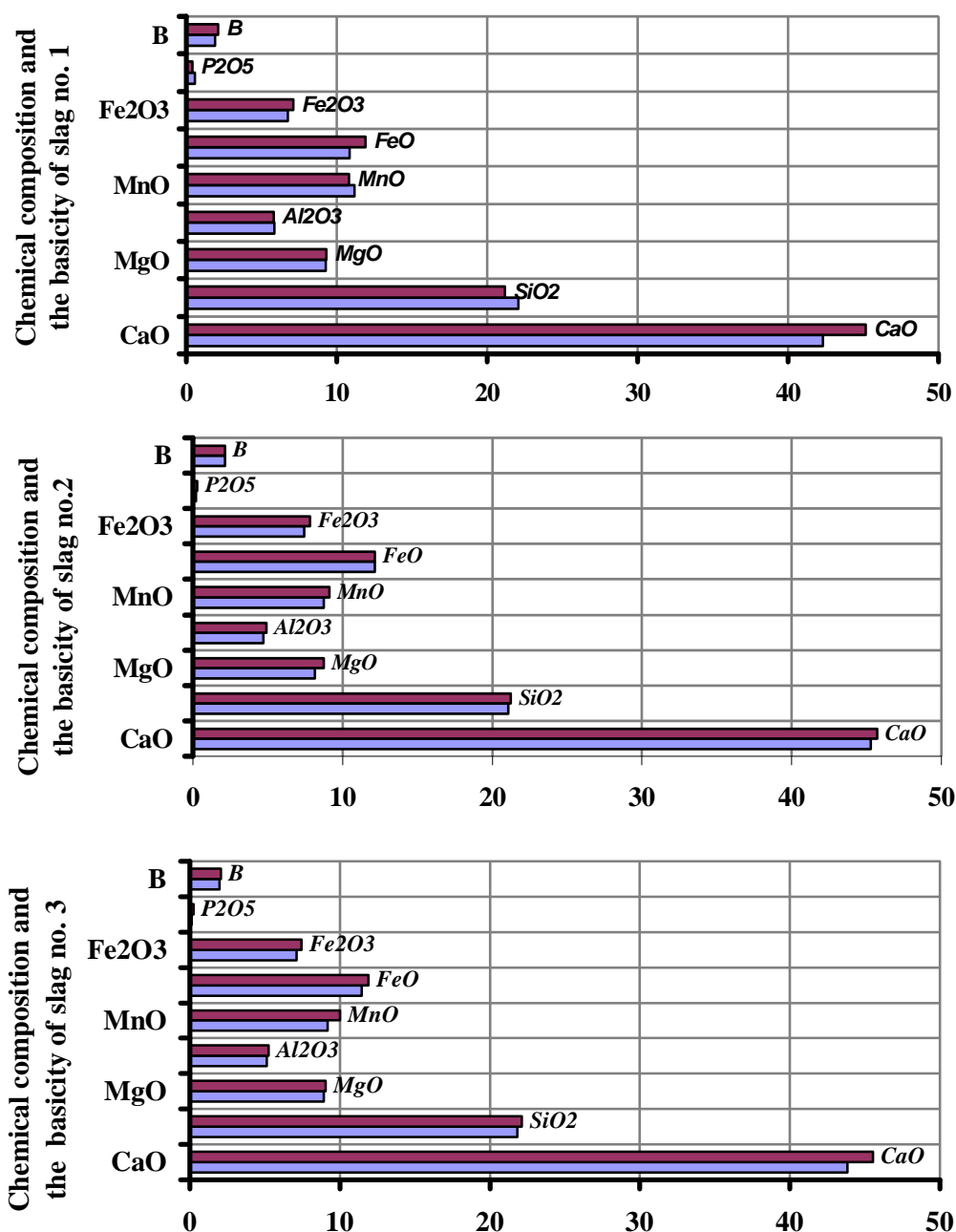


FIGURE 3. THE CHEMICAL COMPOSITION OF THE SLAG, FOR THE THREE CHARGES, AFTER 5 min. AND AFTER 10 min. FOR THE ADDITION

Table 6. presents the removed sulphur and phosphorus quantities. It is to be noted that the faster the slag is formed, the greater the capacity for de-phosphorisation and de-sulphurisation is (figure 4.), so a decrease of P and S in the metallic bath takes place. This means that from this point of view, too, the most convenient variant is the charge no. 2, of pellets produced with recipe no. 1 (R1).

TABLE 6. P AND S QUANTITIES REMOVED FROM THE METALLIC BATH

Removed element	Number of charges / sampling moment					
	1*	2*	3*	1**	2**	3**
ΔP	0,001	0,0015	0,0012	0,002	0,0028	0,0025
ΔS	0,001	0,0012	0,0011	0,002	0,0023	0,0022

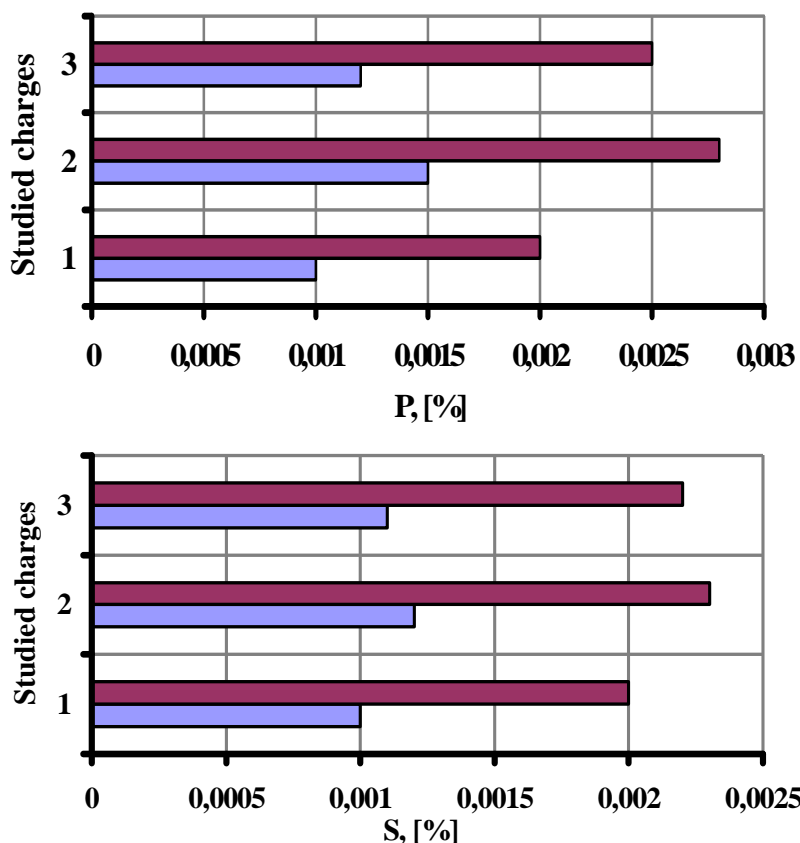


FIGURE 4. P AND S VARIATION IN THE ANALYSED SLAGS

Future experimenting will be done concerning the industrial scale effect and for pellets produced with recipes 2, 3 and 4.

3. CONCLUSIONS

Having in view the researches and the experiments that were done, the following conclusions resulted:

- the pulverous ferrous additions can be used to produce complex additions, which are very useful for active slag formation;
- from the point of view of the pellets' chemical composition and that of the CaO content, the pellet production is recommended to be done with recipes 1 and 2;
- from the point of view of the compression resistance, the pellets are adequate to be used in electric arc furnaces.

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