ECOLOGICAL BRICKS PRODUCING USING DIFFERENT WASTE

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Abstract: *There is a national and international seek for solutions of turning to account the existing offals and also for trying to create ecological conditions in the areas where they have been stored. This offas' turning to account are also necessary due to the considerable diminution of the fossil fuels. This thesis presents one possibility of turning to account the produced offals in the mining, petrochemistry and wood processing industries through their briquetting by a recipe that can satisfy not only the consumers' demands regarding the caloric power, granulometry, mechanic resistance, burning behaviour, but also those regarding the composition of the given gases as a result of the burning. The diminution of the dioxide sulfur given off as a result of the fossil fuels' burning becomes an important problem and that is why in all my tested recipes I have introduced a desulphurization agent, even though it brings to a diminution of the caloric power.*

Key words: *slurry, coke, molasses, lime, sawdust, non-pollutant bricks*

1. Introduction

There is a national and international seek for solutions of turning to good account the residues produced in industry. The capitalization of coal sludge having resulted from processing and deposited on decantation ponds as well as the ecological processing of such areas represent the object of a large number of studies.

In the case of coal sludge we analysed the possibility of briquetting with vegetable binding agents and desulphurization agents such as CaO, $Ca(OH)_2$, $CaCO_3$. Through briquetting we target the obtaining of a product that can be used by domestic consumers, resistant enough to bear transportation, handling and storage without degradation of its granulometric features together with low costs of production and the decrease of the amount of sulphur dioxide produced while burning.

2. Characteristics of the materials used during the process

Coal sludge used for carrying out the attempts of briquetting is collected from no. 2 decantation pond within Coroesti Coal Processing Plant. It was first put to work in 1968, while, at present, it is out of duty. It is located after the two compartments of no. 1, A and B, pond, in the right part of Jiu riverside.

Its total surface represents 10.8 ha, at the level of the beach measuring 7.5 ha.

Until the moment it ceased functioning, the pond stored an amount of approximate 2 million tons of coal sludge having resulted from coal washing.

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For the experimental trials, a series of samples have been taken, from different areas and depths; after homogenization, we determined the content of ash (60.6 %) and caloric content (2700 kcal/kg).

From the granulometric viewpoint, the analyses show that the material is mainly made of fine grains with sizes below 0.2 mm. The humidity of the coal sludge ranges around 20-35 %.

Molasses (Figure 1) is the secondary product of manufacturing sugar from white beet or sugar cane, which does not allow the extraction of sucrose through the technology of crystallization and centrifugal action.

It is a dense, viscid, and sticky liquid, brownish to dark brown. Molasses was used in different percentages (6-15%) for bonding.

Fig. 1. *Molasses*

Petroleum coke is a solid substance obtained through the heating and maintaining at a high temperature certain liquid oil waste.

The process of carbon producing is a means of indirect desulphurization for oil raw materials with different sulphur contents. It displays a spongy appearance, with higher contents of sulphur and impurities than the other categories of oil coke.

Fig. 2. *Oil cokes*

The use of oil coke as fuel with low amount of ash for central heating plants, furnaces for cement or domestic heating devices is limited by the high caloric power and the large amount of sulphur.

The main features of the coke used at trials are displayed in Table 1.

Table 1. *Features of coke employed*

Composition	U.M.	Value
Density	[g/cm^3]	0,64
Humidity	[%]	6,2
Volatile	[%]	26,72
Ash	[%]	18,53
Calorific power	[kcal/kg]	5807

Through using oil coke we get high caloric power briquettes that allow their use in common heating systems.

Desulphurization agent - Ca $(OH)_2$ was used in proportion of 7% from the total amount of briquetting mixture.

Woody sawdust is another residue of wood processing industries. Its use in briquette recipes is due to its low ignition temperature, so that a better burning behaviour of the briquettes comes out.

3. Experimental results

Starting from the results of the previous researches, both internal and international, a series of recipes have been settled, while varying the content of the stuff employed and work pressure. Meanwhile, we analysed their effect upon getting briquettes displaying proper resistance, caloric power and composition of the gas having resulted after burning.

Table 2 shows a series of recipes used for getting briquettes.

Table 2. *Composition of a series of mixtures used for briquetting*

Recipe	Slurry (%)	Coke (%)	Molasses (%)	Lime (%)	Sawdust (%)
P1	37,0	37,0	6	7	13
P2	43,5	43,5	6	7	0
P3	36,0	36,0	8	7	13
P4	42,5	42,5	8	7	0
P5	35,0	35,0	10	7	13
P6	41,5	41,5	10	7	0
P7	34,5	34,5	11	7	13
P8	41,0	41,0	11	7	0
P9	33,5	33,5	13	7	13
P10	40,0	40,0	13	7	0

The analysis of pressure resistance depending on the composition of the mixture employed (Figure 3) shows that, at pressures up to 30kN, briquettes that are made of sawdust (recipe no. 3 and 4) have a higher resistance than those where sawdust is not included. Also, the analyses show that in the case of sawdust mixtures the increase of work pressure over 30 kN does not determine an important increase of pressure resistance.

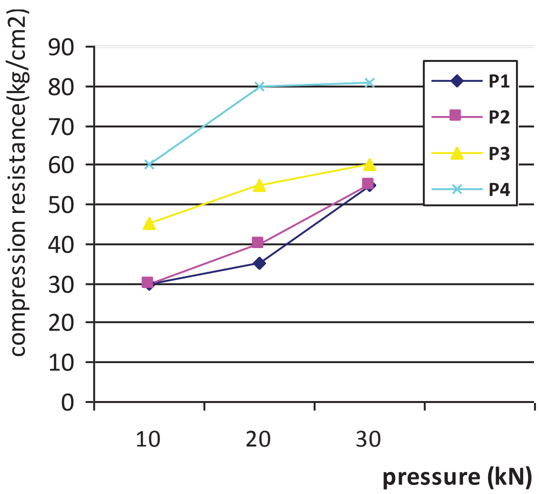

Fig. 3. *Resistance to pressure depending on work pressure in case of various mixtures*

Meanwhile, for briquettes obtained from coal sludge, oil coke, lime and molasses the growth of pressure has a positive effect on briquettes resistance, but this thing leads to a considerable cost of production.

The chart of pressure resistance depending on the consumption of bonding agent (Figure 4) shows that for consumptions up to 8% a slight resistance to compression is registered; in the case of consumptions higher than this value, briquettes resistance significantly grows. Settling an optimal consumption of the bonding agent should consider resistance to pressure, resistance to cohesion, aspects regarding the costs of acquisition and transportation as well as technological aspects. With these in view, in the case of consumptions over 13%, a fluidization of the material occurs when pressing at pressures higher than 10kN, which determines its migration and certain issues connected with technology. Also it can be noticed that sawdust improves the resistance characteristics of the briquettes obtained with the same consumption of bonding agent.

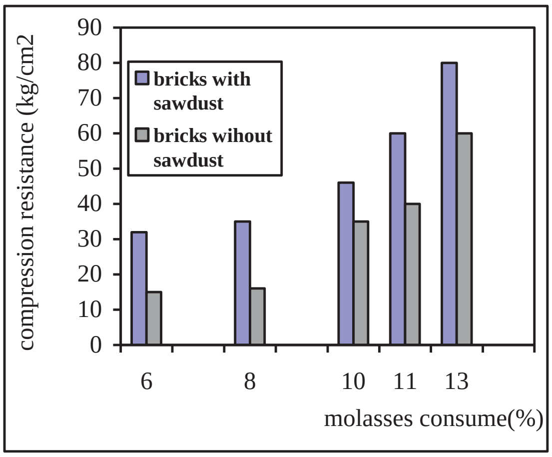

Fig. 4. *Resistances depending on the consumption of bonding agent*

The use of sawdust determines a decrease of molasses consumption, increases the resistance to pressure, the index of cohesion and improves the process of ignition.

The analysis through Fast Vac. Method of recipes 7 and 8 that matches the resistance to pressure and display a high cohesion index shows the presence of the following substances (Table 3):

Table 3. *Chemical composition of briquetting mixtures*

Substance	*Chemical composition for recipe 7(%)*	*Chemical composition for recipe 8(%)*
SiO_2	14,1	17,0
C	56,8	57,4
Na_2O	0,317	0,243
MgO	0,436	0,457
Al_2O_3	7,85	9,95
P_2O_5	0,0377	0,0373
SO_3	6,03	5,27
Cl	0,0566	0,0273
K_2O	1,77	1,37
CaO	9,83	5,55
TiO_2	0,408	0,433
V_2O_5	0,119	0,0818
Cr_2O_3	0,0127	0,0173
MnO	0,0252	0,0206
Fe_2O_3	2,11	2,03
NiO	0,0336	0,0253
CuO	0,0111	0,00807
ZnO	0,0151	0,00824
Ga_2O_3	-	0,00232
As_2O_3	0,0160	0,0000445
Br	0,0142	0,0112
Rb_2O	0,00739	0,00780
SrO	0,0184	0,0152
Y_2O_3	0,00532	0,00386
ZrO_2	-	0,0122
Pt	0,00594	0,00525
Sumă	100	100

The analyses show the decreased content of metals that might turn into vapours. Meanwhile, gallium and zirconium may be observed within the blends that contain sawdust as well as an increase of carbon content.

Table 4 shows an inventory of pollutant emissions caused by briquettes combustion. As it can be seen, all the emissions caused by the combustion of coal briquettes combustion are below the limits stipulated by the existing regulations.

Table 4. *Pollutants emission caused by briquettes combustion*

No.	Exhaust pollutant in stack	Determined concentration [mg/Nm^3]		Allowed concentration [mg/Nm^3]		Exceeding	Determination method
		In proof	Average	Law	Allowed value*		
1	Powders in suspension	58	63.2	Order MAPPM no. 462/93, Annex 2	100	No	Gravimetric with glass fiber filter
		76					
		52					
		38					
		92					
2	SO_2	132	132		2000	No	Colorimeter
3	NO_2	16	16		500	No	Colorimeter
4	CO	895	895				Colorimeter

- Note: Allowed concentration are for steam power plants < 100MW/t

4. Conclusions

The use of sawdust leads to the growth of briquettes resistance obtained when employing the same work pressure and bonding agent.

In the case of sawdust briquettes, the growth of pressure over 30kN does not determine considerable improvement of resistance, while in the case of briquettes without sawdust, a higher pressure is absolutely necessary. The increase of the content of molasses determines the increase of the resistance of the briquettes, but consumption higher than 15% creates technological problems.

Sawdust improves the behaviour at ignition and burning due to ignition temperatures lower than those of coke and coal sludge. For the storage and selling of the briquettes obtained it is necessary to have in view the enforced sacking and reservation of the mixtures in locations safe from humidity.

The technological flux of this type of briquettes is simple enough and does not require supplemental costs regarding the use of the heat carrier.

The presence of the desulphurization agent reduces the emissions of the oxides of sulphur, while the ash resulted, due to presence of gypsums and the low content of heavy metals, may be used for soil improvement.

In the case of the improper briquettes at pressure resistance, fissures were noticed at bur (Figure 6).

Fig. 5. *Briquettes from coal sludge, oil coke, sawdust, Ca $(OH)_2$, lime and molasses*

Fig. 6. *Cracked briquettes (when recipe 2 was used)*

The most rational orientation under the actual circumstances is producing bio-briquettes.

In China – an important consumer of coal - ecological briquettes are made of coal, calcium hydrate and biomass (straws, wood, wastes, agricultural wastes). These materials are mixed and then are casted under pressure in briquette machines. The resulted ash after the briquettes combustion has a favourable composition for using it in soil improvement.

Lime plays the role of a desulphurizing agent, which, dispersed among coal grains, favours the catalytic reaction between the sulphur from the stack and this desulphurizing agent during the combustion process. The sulphur, in proportion of 60-80%, is being fixed in solid non-pollutant compounds which remain within ash.

The main advantages of these bio-briquettes:
- They produce less smoke;
- High burning reactivity – because of the wood fibres mixed in briquettes composition;
- They don´ t produce smoke
- They decrease the content of SO_2 in burning gases.

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