DESCRIPTION OF PELLETIZING FACILITY

by

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A lot of electrical energy in Serbia was used for heating, mainly for domestics. As it is the most expensive source for heating the government announced a National Program of Energy Efficiency with only one aim, to reduce the consumption of electric energy for the heating. One of the contributions to mentioned reduction is production of coal pellets from the fine coal and its use for domestic heating but also for heating of schools, hospitals, military barracks, etc. Annual production of fine coal in Serbia is 300,000 tons. The stacks of fine coal make a lot difficulties to the each mine because of environmental pollution, spontaneous combustion, low price, smaller market, etc. To prevent the difficulties and to give the contribution to National Program of Energy Efficiency researchers from the Department of Mining Engineering, University of Belgrade, designed and realized the project of fine coal pelletizing. This paper describes technical aspect of this project.

Key words: *pelletizing, coal fines, energy efficiency*

Introduction

For proper understanding the reason why pelletizing of coal fines from deep coal mines in Serbia is interesting and acceptable it is necessary to say that only one third of total production of around 600,000 t/yr from 8 mines can be supplied to one thermal power plant (110 MW). Remaining amounts of production are sold at the free market. In this situation the demand for larger classes is considerably higher than demand for smaller classes and fines. Therefore stock piles of coal fines (–15 +0 mm) are present at each mine, which have unfavorable effect at the mine economics as well as negative influence at environment. In order to overcome this problem experts from the Faculty of Mining and Geology, University of Belgrade, have completed research project with the task to determine were the pelletizing of coal fins with PELLET MILL machines, from the technological and economical point of view, is justifiable approach for solving the issue of coal fines.

Four basic conditions that need to be met before starting industrial production are: technology, economical feasibility, environmental requirements, and market analysis.

First three of these conditions are already met. Technology is defined and proven. Economical analysis showed that production of pellets can generate profit, and

concerning environmental issue, pelletizing would eliminate coal fines stockpiles thus preventing pollution and environmental degradation. Market analysis was the last condition to be met, and it was found that demand for coal in Serbian market is approximately 2 million tons per year, excluding power and heat generation (power plants and heating plants). This market is supplied from lignite open pits and coal import (over 200,000 t/yr), beside the production from deep coal mines. Therefore it can be concluded that the market for coal pellets is extensive.

Production of pellets from deep coal mines fine coal have additional important aspect, beside four above mentioned. It is contribution to energy efficiency or reduced consumption of electricity for heating purposes. Consuming of electric energy for heating had to be stopped and the new government of the Republic of Serbia formed and started a National Energy Efficiency Program (NEEP). Within framework of this program project for fine coal pelletizing was developed. Following completion and review by the Board of NEEP, project is evaluated as very good and perspective one. Basic principles of technological process of fine brown coal pelletizing are presented in remainder of this paper.

Technology of fine brown coal pelletizing

Before selection and specification of equipment for industrial – demo pelletizing facility, it was necessary to complete examinations in laboratory followed by production on semi-industrial pelletizing facility. Results and experiences gained during these examinations enabled researches to determine all the elements of pelletizing technology for complete industrial facility.

The CPM machine model 7900 (fig. 1), was acquired for the first industrial production with following characteristics: AC motor power 110 kW, motor speed 1500 rpm, die type A25, active width of the die 156 mm, inside diameter of the die 572 mm, capacity 5 t/h.

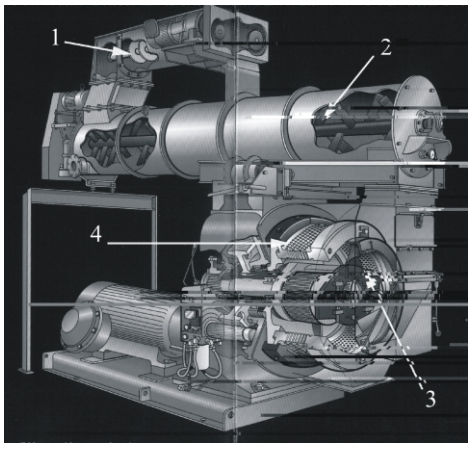

Figure 1. CPM pellet mill type 7900
1 – Screw feeder,
2 – Continuous mixer,
3 – Pelletizing section,
4 – Die

After establishing regular production, the plant was comprised of the following components: coal fines hopper, coal fines conveyor belt, hopper for the screw conveyor, screw conveyor, continuous mixer – conditioner, binder reservoir, pump and pipelines, pellet mill, product conveyor belt, and product hopper.

Results of industrial pellet production are shown in tab. 1. Quality of pellets produced in industrial facility was better compared to pellets produced in semi-industrial facility.

Table 1. Quality of pellets produced in industrial pelletizing facility

Sample mark	Compressive strength	Elastic wave velocity		Modulus	Poisson's coefficient
	σ_p [kN/m^2]	v_p [m/s]	v_s [m/s]	E_{dyn} [GN/m^2]	μ_{dyn}
1n	7830	1683.33	801.39	2.78	0.34
2n	3810	1004.04	516.37	1.06	0.32
1p	6190	1020.92	528.77	1.08	0.32
2p	6138	796.27	401.92	0.63	0.33

n – dry screened coal, p – clean (washed) coal, v_p – longitudinal waves, v – transversal waves

It is important to emphasize determination of optimal ratio of die openings diameter and length of openings (d : h). Research showed that for pelletizing of brown coal from Serbian mines this ratio is 1 : 5.5. When this ratio is bigger than 1 : 5.5 *i. e*. larger diameter and shorter length of the die opening, a considerable amount of fine coal is dropping through the die openings while the quality of produced pellets is poor. When the ratio is smaller than 1 : 5.5, mixture of fine coal and binder is blocking the die openings since the pressure force is insufficient.

Description of pelletizing facility

Technological scheme of the pelletizing facility is shown on the fig. 2.

Dry screened coal falls from the screen (14) onto belt conveyor (15) which is equiped with plough for directing the coal into the storage bunker (1). There is possibility for loading the coal with wheel-loader over the bin (2), located on belt conveyor (3). Fine coal (–8 +0 mm) from the bunker is transported by conveyor (3), equipped with weight measuring device (4). Controlled feeding of pelletizing machine is ensured with installation of frequency regulation of drive at conveyor (3). From the pelletizing machine (5), final product is transported with belt conveyor (6), toward packing device or bunker of final product. Conveyor (6) is equipped with plough (7) for directing pellets into the packing device (8), otherwise, pellets are stored at the bunker (9). Available height under the bunker (9), for the trucks, is 3,6 m. Belt conveyor (6) also have a purpose for cooling

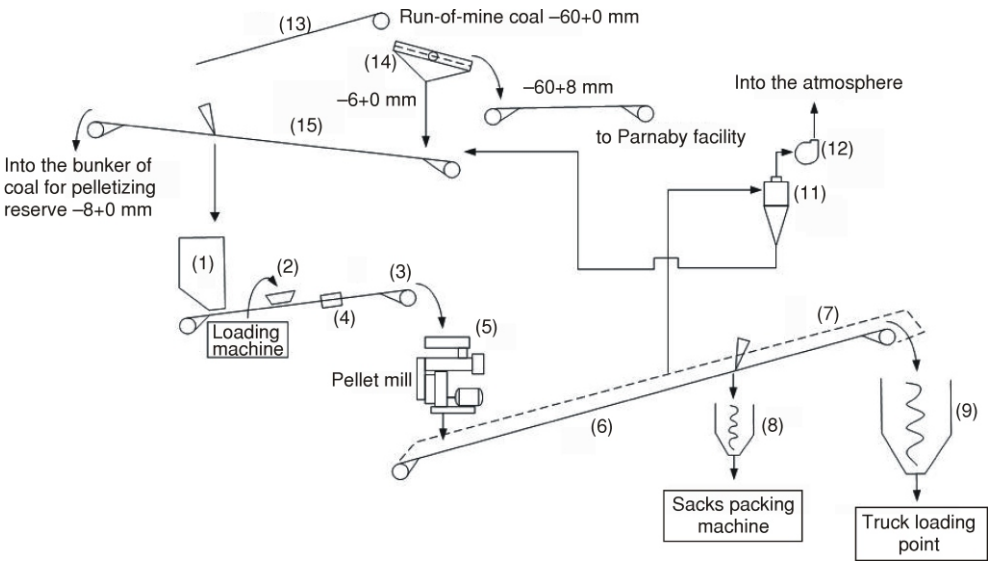

Figure 2. Technological scheme of the pelletizing facility
(*1) bunker, (2) bin, (3, 6, 13, and 15) belt conveyor, (4) weight measure device, (5) pelletizing machine, (7) plough, (8) packing device, (9) bunker of final product, (11) air-cyclone, (12) fan, (14) screen*

the pellets and for that purpose it is equiped with armor for air circulation and de-dusting with air-cyclone (11) and fan (12). Basic elements of facility are presented on fig. 3.

Figure 3. Basic components of the facility

Conclusions

Pelletizing of fine coal with pellet mills is without doubt acceptable (reasonable) enterprise for deep coal mines in Serbia, having in mind that considerable percentage of total production from all the mines are coal fines, that the price of coal fines are lower and that its market is not persistent, especially during the summer. Coal fines stockpiles are degrading the environment and also they are representing constant pollution threat. Therefore, it is our opinion that coal fines should be transformed into the more quality fuel. Pelletizing technology based on the pellet mills, as it is proven in developed project, could meet all stated conditions.

Fine coal pelletizing is already proven technology, but since it is a new technology in Serbia, for successful application it was necessary to adjust technical parameters in order to make a product of best possible quality. This factor, together with the price of final product, is very important for successful marketing of pellets and acceptance of consumers. Most important technological and technical parameters that need to be met in order to have successful production are:

- Coal fines from each mine have to be examined in laboratory and tested with different types of binder for determination of optimal amount. Quality of laboratory samples also should be determined to ensure successful and economical pelletizing.
- Certain amount of coal fines (from 10 up to 50 t) should be treated, with selected binder, in existing pelletizing facility.
- Produced pellets should be tested and their quality determined in case that some technological (moisture content, type and amount of binder, homogenization of coal fines and binder, *etc*.) and technical (type of die, die diameter and thickness, rollers clearance, *etc*.) parameters should be adjusted.
- Testing the quality of produced pellets is important to find out the amount of undersized pellets. In case that stability of pellets or the amount of undersized pellets are not acceptable it is necessary to check and re-adjust above-mentioned technological and technical parameters, with following test production. This cycle must be repeated until the production of quality pellets is achieved.

Developed project demonstrated that adjusting technical parameters could produce high quality pellets. Two years of research were needed for this achievement and finally it can be stated that all conditions are met for successful pelletizing which is important for deep coal mines in Serbia.

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