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CONCEPT OF DIMENSIONING AND DEVELOPMENT OF BULK MATERIAL STOCKPILS

Iosif Gruneantu[1], , Iosif Andras[2], Sorin Noaghi[3], Livia Ilias[4]
[1,2]Ph.D, [3]Assoc. Prof. PhD., [4]Eng
University of Petrosani, str.Universitatii, nr.20

Abstract: *In market economy conditions, where discrepancies may occur between demand and offer, coal deposits resulted from exploitation are indispensable elements of producing, processing or consuming units. A concept was developed for the sizing and building of deposits, characterized by simplicity, maximum efficiency and minimum investments. A correlation was established between accumulation capacity, technical-functional characteristics and size of deposits.*

At present, the main coal consumers of coal extracted in Romania are energy producing units. Due to the occasionally relative diversity and share of energy resources in energy production instability occurs on the coal market.

In future, coal mining and energy suppliers will have to follow the rules of market economy and to provide competition capacity in order to sell their products.

In these conditions, a deposit is necessary, as an intermediate structure, which would store for a certain period the extracted coal, between coal suppliers, represented by coal mines and the beneficiaries.

Deposits are intended to accumulate and keep for a certain period of time raw coal, sorted or washed, providing operation independence to preparation plants and mining companies. They offer the possibility of satisfying the demands on the coal market with a certain independence to the outputs of the mines.

In the relationship between the mines and the market, the deposit can assume various positions as in Fig. 1.

At least two essential aspects should be outlined in the design and creation of coal deposits, as intermediate locations between suppliers and beneficiaries:

- Establishing the location of the deposits;
- Sizing the deposit capacity.

Establishing the location of the deposits is a delicate and difficult issue, since in the present social-economical conjecture a series of technical and legal constraints occur related to the conditions that should be met by the location.

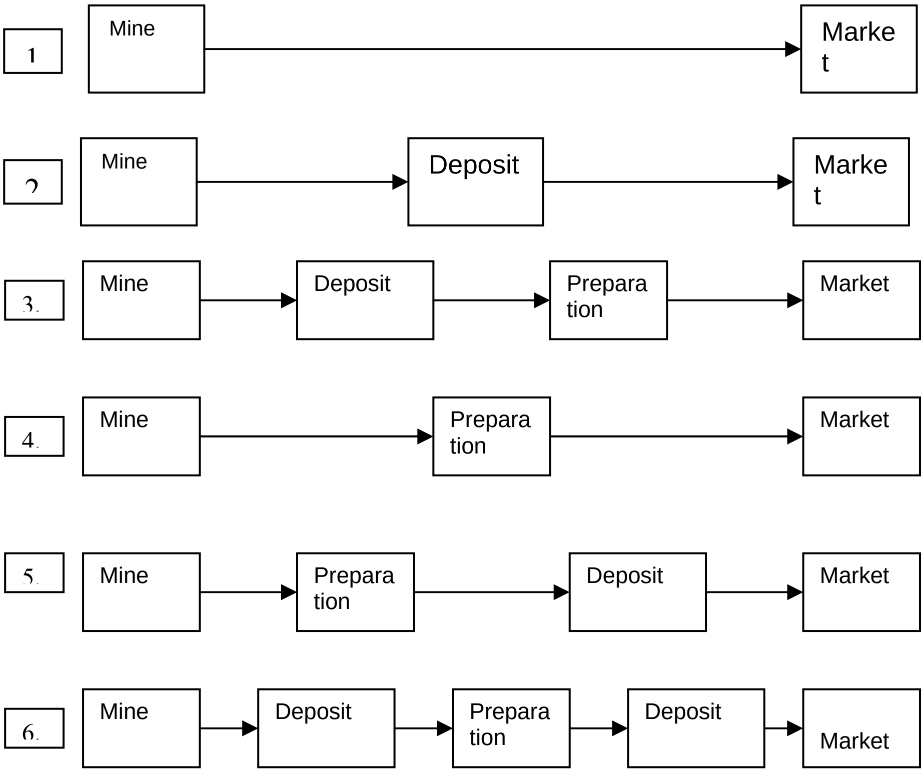

Fig. 1 – Deposit location in the the mine - market relationship

Establishing the Capacity of the Deposit

To calculate the depositing capacity and for suggestions of building them, the following hypothesis are put forward:

- A situation where all the output should be stored;
- Possibility of planning deliveries , so that inputs in the deposit should be constant all along the day;
- Succession of depositing , and delivery operations, respectively.

Considering the maximum predicted annual output (Q_a) for 2006 – 2010, specific to the year 2010, it is found that daily production (Q_{zi})of the National Bituminous Coal Company is:

$$Q_{zi} = \frac{Q_{an}}{n_{zla}} = \frac{2796000}{255} \cong 11000 t / zi \qquad (1)$$

where:

$$Q_{an} = 2796000 \text{ t/year} \qquad (2)$$

$n_{zla} = 255$ - number of working days in a year.

The deposit capacity will be:

$$Q_d = 15 \times Q_{zi} = 165000t \tag{3}$$

Considering that all mine units deliver coal in railway wagons, in case there is no coal delivery to the beneficiary, the number of wagons (n_v)dumped in the deposit in a day will be:

$$n_v = \frac{Q_{zi}}{Q_v} = \frac{11000}{55} = 200\,pieces \tag{4}$$

where:

$Q_v = 55t$ - capacity of a wagon.

The number of wagons thus calculated will be used for the sizing of capacity of coal dumping from wagons.

To chose the necessary machinery to deposit coal, the capacity per hour of depositing is calculated:

$$Q_h = \frac{Q_{zi}}{n_{hf}} = \frac{11000}{20} = 550t/h \tag{5}$$

where:

$n_{hf} = 20hours$ - hours of machinery operation per day.

As a concept, the deposit arrangement assumes a plane concrete surface, in the center of which a concrete bridge is built where the railway required to empty the wagons is assembled.

Geometric Shape of Coal Stacks

Coal stacks are coal piles of the shape of a rectangular frustum of a pyramid.

Stacks are defined by the following dimensions:

H_s –stack height (no shape), m;

l_{is} –lower stack width , m;

l_{ss} –upper stack width, m;

L_s – stack length, m.

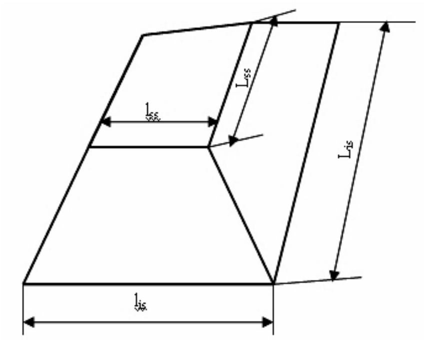

Fig. 2 Geometrical shape of the stack

Establishing Stack Dimension

Stack height

Stack height depends on the height (H_s)at which the discharge arm of the depositing machinery can be positioned.

Following coal leveling and settlement, the stack height decreases.

Thus:

$$H_s = (0,80 \div 0,85)\ H_d,\ \text{m} \qquad (6)$$

Where:

H_d – height of the machinery discharging arm, m.

Stack width

Since in our proposal we considered that the same machinery, rotor excavator, will do both coal storage (Fig. 3) and its loading in the deposit (Fig. 4) to the wagons on the bridge, its lower width (l_{is})is determined by the constructive – functional dimensions of the machinery. Rotor excavators, due to their mobility could be thus positioned as to make the best use of the deposition surface.

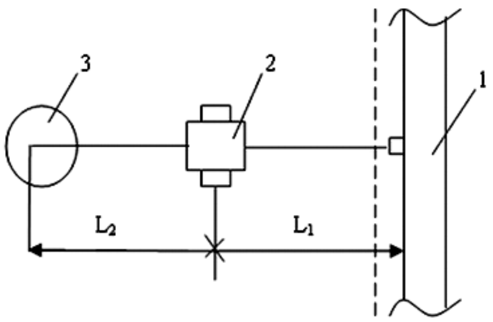

Fig. 3 – Coal deposition in stacks

Due to technical – functional considerations of the system, the lower width of the stack (Fig. 1.3) is:

$$l_{is} = L_1 + L_2 - \left(l_c + l_u + l_p + \frac{l_{ie}}{2} \right),\ \text{m} \qquad (7)$$

L_1 –rotor holder, m:

L_2 –excavator dumping arm length, m;

l_c – travel passage width, m;

l_u –machinery width, m;

l_p – width of coal prism dumped from wagons, m.

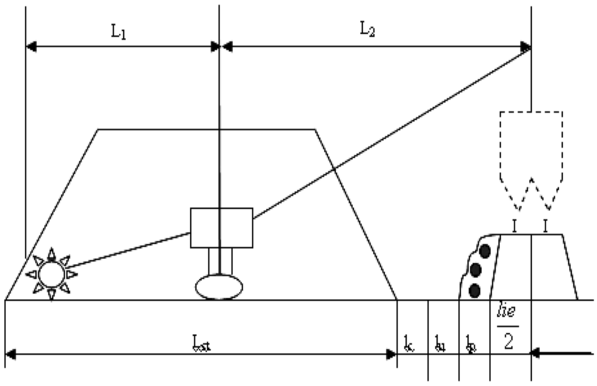

Fig. 4 – Coal dumping in stacks

Upper width of the stack (Fig. 4) is a resultant of magnitudes determined above.

Fig. 4 – Calculation diagram of the upper stack width.

$$l_{ss} = l_{is} - 2 \cdot \frac{H_s}{tg\alpha_2} \qquad (8)$$

$$\text{or } l_{ss} = l_{is} - 2 \cdot \frac{H_s}{tg\alpha_2} \qquad (9)$$

<u>4,2,4,2,3, Stack length</u>

Stack length (L_{st}) is determined by calculation, function of the coal amount to ne deposited. In calculations the stack volume is used:

$$V_S = \frac{Q_S}{\gamma}\ m^3 \qquad (10)$$

Where

γ - volumetric mass of the coal in the deposit, t/m^3

The stack volume is calculated with the equation:

$$\begin{aligned}
V_S &= \frac{1}{2}\left(L_{is} \cdot l_{is} + L_{ss} \cdot l_{ss}\right) \cdot H_s = \frac{1}{2}\left[L_{is} \cdot l_{is} + \left(L_{is} - \frac{2 \cdot H_s}{tg\alpha_2}\right) \cdot \left(l_{is} - \frac{2 \cdot H_s}{tg\alpha_2}\right)\right] \cdot H_s \\
&= \frac{H_s}{2}\left(L_{is} \cdot l_{is} + L_{is} \cdot l_{is} - \frac{2 \cdot H_s \cdot l_{is}}{tg\alpha_2} - \frac{2 \cdot H_s \cdot L_{is}}{tg\alpha_2} + \frac{4 \cdot H_s^2}{tg^2\alpha_2}\right) \\
&= \frac{H_s}{2}\left[L_{is}\left(2 \cdot l_{is} - \frac{2 \cdot H_s}{tg\alpha_2}\right) - \frac{2 \cdot H_s \cdot l_{is}}{tg\alpha_2} + \frac{4 \cdot H_s^2}{tg\alpha_2}\right] \\
&= L_{is} \cdot \frac{H_s}{2}\left(2 \cdot l_{is} - \frac{2 \cdot H_s}{tg\alpha_2}\right) - \frac{H_s^2 \cdot l_{is}}{tg\alpha_2} + \frac{2 \cdot H_s^3}{tg^2\alpha_2},\ \text{m}^3
\end{aligned} \qquad (11)$$

This equation gives the stack length value, function of the value of required or calculated parametners according to the methodology shown.

$$L_{is} = \frac{\frac{Q_s}{\delta} + \frac{H_s^2 \cdot l_{is}}{tg\alpha_2} - \frac{2 \cdot H_s^3}{tg^2\alpha_2}}{H_s \cdot l_{is} - \frac{H_s^2}{tg\alpha_2}} \quad (12)$$

Conclusions

Calculation methodology provides the beneficiary with the possibility of estimating, for a type of machinery given, the dimensions of the deposit components, and thus of the necessary investment.

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