

# Thermophysical processes in dry granulation of metallurgical slags

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Mathematical model for theoretical analysis of thermophysical processes of melt drops solidification is examined during their motion inside cooling gas, applying to granulation task. The heat exchange equations during granulation, taking into account convection, heat conductivity in solid phase and Stefan conditions on the boundary of phase transition, are presented. The relationships characterizing correlation of the power exchange parameters in dispersed medium are obtained in the conditions of phase transition in melt drops inside gas phase flow. Analytical relationships allow to consider correlation of the parameters which characterize granulation process, to provide directions of efficient conduction of the processes for achieving the preset aims and to reveal the conditions for optimal technological parameters of the process. Speed of the power exchange processes determines the size of an installation and allows to make preliminary assessment during designing. Different motion modes for particles and gas are investigated. The variants for calculation of gas dynamic parameters of straight flying trajectory for a slag melt particle are suggested; they are based on solving the problem of particle motion in the gas medium, taking into account particle size, medium resistance, initial particle speed. Used relationships allow to assess the particle flying time, which is corresponded to the required time of particle cooling during its flying, and to choose programming conditions for motion of dispersed jet of slag melt. These conditions guarantee forming of solid crust on the cooled particle and possibility of size determination for a granulation system. Possible scheme of slag heat realization, allowing to utilize maximally the exergy of secondary power resources, is considered. The obtained results can be used for improvement of the existing installations for dry granulation and for designing of the new ones, as well as for optimization of operating modes of granulators, for their efficiency rise and increase of power saving possibilities for a granulation system.

**Key words:** dry granulation, metallurgical slag, solidification, heat exchange, mathematical model, aerodynamics of particles, heat utilization, exergy potential.

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## Introduction

Large amount of investigations and patents about granulation processes of blast furnace slag melts in iron and steel industry [1–6] testifies on actuality of this theme; as well, large amount of works [7–9] is devoted to modeling of information systems and processes. Ground granulated slag is widely used in production of concretes mixed with Portland cement. For example, slag output in a modern blast furnace makes 200–500 kg per 1 t of cast iron. Large-volume blast furnace provides melting of 8,000–12,000 t of cast iron per day, thereby annual slag output in such furnace makes more than 1 mln. t. Granulation technological routes can be divided to wet technology (with granulation on cooled surface) and dry technology [10, 11]. The part of losses with slag heat achieves 30 %, in particular for electric thermal technologies. Use of slags heat depends substantially on granulation method. The following factors can be mentioned among the deficiencies of the wet technology: low temperature, water exergy and impossibility of complete use of heat exergy potential [11]. Dry slag granulation is a relatively insufficiently developed

technology, where granules are obtained from molten slag (e.g. as by-product during cast iron melting in a blast furnace) without water addition for slag cooling and solidification. Slag can be obtained from metallic melt, such as cast iron or metal oxide based melt (e.g. titanium oxide), or their mixes. The temperature of tapped slag achieves 1350–1400 °C, with enthalpy 1,600–1,800 kJ/kg, what provides heat loss with slag about 3.5–5.0 % during blast furnace practice. Slag use during electric thermal processes is also very actual [12–15]. Possibility of utilization of blast furnace slag melt heat with high exergy potential for obtaining of hot air and consequently overheated steam leads to saving of expensive coke and natural gas and can be considered as the main advantage of the dry granulation technology. This technology has also advantages both in its efficiency and potential (i.e. in air exergy), because it allows to heat air up to high temperature and consequently increases possibility of its use as power carrier [1, 16, 17]. The temperature of air heating is determined by construction of a granulator, by the mode of slag dispersion, by hydrodynamics and heat exchange of air and particles [2, 3, 18, 19]. Dry granulation is realized by air, which effects

on a slag melt jet and provides its comminution. Granules fly several meters and then are subjected to cooling, solidified and entered into collector. The methods of dry granulation of blast furnace slag using compressed air are known; they are characterized by air consumption 2,400 m<sup>3</sup>/min and pressure 6.5 kPa [10, 11], as well as using whirled flow of gas suspension, which moves downstream in a cyclone-type chamber with vertical axis [20].

This work is devoted to consideration of coupled heat exchange between “dancing” blast furnace slag particles and gas phase heat carrier.

### Mathematical model of solidification of blast furnace slag melt in air-gas flow

The equations describing heat exchange during blast furnace slag melt granulation, take into account the convection mechanism of heat removal from solidifying slag and its transfer via in solid phase heat conductivity, based on the conditions of Stefan task on the boundary of phase transition [21].

It is accepted that power transfer along the vertical coordinate  $y$  is conducted via convection, and inside blast furnace slag particle – via heat conductivity. Temperature distribution in the melt (drop) is homogenous.

Power balance for gas phase in solidified material (particle) in the process of exchange with a cooling agent and on the boundary of phase transition  $\xi^*$  can be presented as:

$$\rho_g c_{pg} (v_g + v_s) \varepsilon \frac{dt_g}{dy_*} = \alpha_F f_v (t_g - t_{s0}) \quad (1)$$

$$\lambda \left( \frac{dt_s}{dr_*} \right)_{x_s = x_{s0}} = \alpha_F (t_g - t_{s0}), \quad (2)$$

$$\lambda \left( \frac{dt_s}{dr_*} \right)_{x_s = \xi_*} = \rho_s Q_L \frac{d\xi_*}{dt_*} \quad (3)$$

with the boundary and initial conditions

$$y_* = 0, t_g = t_{g0}, r_* = r_{s0}, t_s = t_{s0}, r_* = \xi_*, t_s = t_L, \quad (4)$$

$$\tau_* = 0, d\xi_*/dy_* = 0, \xi_* = 0, y_* = 0. \quad (5)$$

where  $\rho_g, c_{pg}$  – density and heat capacity of gases;  $v_g, v_s$  – speed of gases and material;  $\varepsilon$  – layer porosity (part of volume, occupied by gas phase);  $t_g, t_{s0}$  – temperature of gases and on a particle surface;  $y_*, r_*$  – vertical and radial coordinates;  $\alpha_F$  – heat emission coefficient;  $f_v = 6(1-\varepsilon)/d_s$  – specific surface of particles;  $\lambda$  – heat conductivity coefficient of particles;  $\xi_*$  – solidification front coordinate;  $t_L$  – melting temperature;  $d_s$  – diameter of particles;  $\tau_*$  – time;  $Q_L$  – solidification heat.

If we shall consider the temperature distribution in solidified part of material (particle) as linear, then dimensionless

form of equations for describing of coupled heat exchange during phase transition can be expressed as:

$$\frac{d\theta_g}{dy} = St(\theta_g - \theta_{s0}), \quad (6)$$

$$\frac{\theta_{s0}}{\xi} = Bi(\theta_g - \theta_{s0}), \quad (7)$$

$$\frac{d\xi}{dt} = Bi(\theta_g - \theta_{s0}), \quad (8)$$

where  $\theta_g = (t_g - t_L)/(t_{g0} - t_L)$ ,  $\theta_s = (t_s - t_L)/(t_{g0} - t_L)$  – dimensionless temperature of gas and particle;  $y = y_* f_v$  – dimensionless coordinate;  $f_v = 6(1-\varepsilon)/d_s$  – specific surface of particles;  $Bi = \alpha_F/(\lambda f_v)$  – Bio criterion;  $St = \alpha_F/(\rho_g c_{pg}(v_g + v_s)\varepsilon)$  – Stenton criterion;  $\xi = \xi_* f_v$  – dimensionless coordinate of phase transition front;  $\tau = Ste Fo$  – dimensionless time;  $Ste = c_{pg}(t_L - t_g)/Q_L$  – Stefan criterion;  $Fo = \lambda\tau/(\rho_s c_{ps} f_v^2)$  – Fourier criterion;  $\varepsilon$  – part of the volume, occupied by gas phase.

### Solution of the problem of convection heat exchange during phase transition

It can be concluded from the examined equations:

$$\xi \frac{d\xi}{dt} = \theta_{s0}, \quad (9)$$

$$\theta_g = \frac{1}{Bi} \frac{d\xi}{dt} + \theta_{s0} = \frac{1}{Bi} \frac{d\xi}{dt} + \xi \frac{d\xi}{dt}. \quad (10)$$

Using these expressions, we shall obtain the following equation:

$$\frac{1}{St} \frac{d}{dy} \left[ \frac{1}{Bi} \frac{d\xi}{dt} + \xi \frac{d\xi}{dt} \right] = \frac{1}{Bi} \frac{d\xi}{dt}. \quad (11)$$

Taking the integral by time of (11) we can write down:

$$\frac{1}{St} \frac{d}{dy} \left[ \frac{1}{Bi} \xi + \frac{\xi^2}{2} \right] - \frac{1}{Bi} \xi = g(y). \quad (12)$$

It is concluded from (12), that the left part does not depend on  $\tau$ , thereby it will not vary for any  $\tau$ , though  $d\xi/dy$  и  $\xi$  depend on two variables and this expression can be calculated for any value of  $\tau$ , which is characterized by known values  $d\xi/dy$  and  $\xi$ .

As soon as  $y_* = (v_g + v_s)\tau$ , for  $\tau=0$ ,  $y_*=0$ , then there is no solidification for  $y_* > (v_g + v_s)\tau$ , and  $(d\xi/dy)=0$ . This statement is taken into account initially. Using these relationships as initial conditions, we shall obtain the value of integrating constant.

When  $\tau=0$ ,  $(d\xi/dy)=0$ ,  $\xi=0$ , then  $g(y)=0$ . The last equation (12) can be transformed in the expression which is more suitable for integration:

$$\left[ \frac{1}{Bi} \frac{d\xi}{dt} + d\xi \right] = \frac{St}{Bi} dy \quad (13)$$

The integral (13) looks like:

$$\frac{1}{Bi} \ln \xi + \xi = \frac{St}{Bi} y + c(\tau). \quad (14)$$

The value of integrating constant can be obtained using the conditions  $y_*=0$ ,  $\xi = \xi_z$ , where  $\xi_z$  is the value of the component of solidification front coordinate at the entrance in the area of phase transition beginning.

As soon as  $t_g = t_{g0}$  for  $y_*=0$ , then  $\theta_g=1$  for  $y=0$ , and the solution can be obtained from the equation (10) for gas temperature, which is written taking into account the above-mentioned conditions:

$$\frac{1}{Bi} \frac{d\xi_z}{d\tau} + \xi_z \frac{d\xi_z}{d\tau} = 1. \quad (15)$$

Taking the integral of (15) for the component of solidification front coordinate, we can write down:

$$\xi_z = -\frac{1}{Bi} + \sqrt{\left(\frac{1}{Bi}\right)^2 + 2\tau}. \quad (16)$$

The following relationship will be true for the integrating constant (14):

$$c(\tau) = \frac{1}{Bi} \ln \xi_z + \xi_z. \quad (17)$$

The solidification front coordinate is determined from the non-linear equation

$$\frac{1}{Bi} \ln \xi + \xi = \frac{1}{Bi} \ln \xi_z + \xi_z - \frac{St}{Bi} y. \quad (18)$$

Speed of solidification and temperatures of particles and gas can be obtained from the balanced relationships. Differentiating the non-linear equation (18) by time, we shall get:

$$\frac{d\xi}{d\tau} = \frac{d\xi_z}{d\tau} \left( \frac{1}{Bi\xi_z} + 1 \right) / \left( \frac{1}{Bi\xi} + 1 \right). \quad (19)$$

In this case, the following equation should be taken into account:

$$\frac{d\xi_z}{d\tau} = \left( \left( \frac{1}{Bi} \right)^2 + 2\tau \right)^{-0.5}. \quad (20)$$

For the temperature of particles and gas we have:

$$\theta_{s,0} = \xi \frac{d\xi}{d\tau} = \xi \frac{d\xi_z}{d\tau} \left( \frac{1}{Bi\xi_z} + 1 \right) / \left( \frac{1}{Bi\xi} + 1 \right), \quad (21)$$

$$\theta_g = \xi \frac{d\xi_z}{d\tau} \left( \frac{1}{Bi\xi_z} + 1 \right). \quad (22)$$

Decomposing (14) in a row at initial moment of solidification for small values of solidification coordinate, we shall obtain:

$$\xi = \frac{1 + \ln \xi_z + Bi \xi_z - ySt}{(1 + Bi)}. \quad (23)$$

In this case the equations are linearized and asymptotic behaviour of the system can be analytically evaluated.

The values of dimensionless solidification coordinate depending on time and vertical coordinate are presented in the **Table 1**.

When increasing the Bio criterion, the coordinate of phase transition front weakly depends on the vertical coordinate, because heat removal from a particle is small at low heat conductivity. When Bio criterion is decreasing, convection begins to make retarding effect on heat exchange. Low effect of Stenton criterion on solidification process is caused by the fact that influence of intensification of convection exchange is not so essential for developed heat exchange surface, but when Stenton criterion increases, gas heating degree also slightly enlarges.

**Table 1. Relationship between the solidification front coordinate (from one side) and time and granulator height (from other side)**

St=0.002 at Bi=2					
y \ τ	0.1	0.25	0.5	0.75	1.0
0	0.20	0.38	0.62	0.82	1.0
20	0.18	0.365	0.606	0.80	0.986
40	0.16	0.35	0.592	0.78	0.97
60	0.14	0.335	0.578	0.76	0.954
80	0.12	0.32	0.564	0.74	0.938
100	0.10	0.30	0.550	0.72	0.922
St=0.002 at Bi=20					
y \ τ	0.025	0.05	0.1	0.25	0.5
0	0.195	0.3	0.4	0.65	0.975
20	0.192	0.298	0.398	0.646	0.964
40	0.190	0.296	0.396	0.642	0.953
60	0.188	0.294	0.394	0.638	0.942
80	0.185	0.292	0.392	0.634	0.930
100	0.184	0.290	0.390	0.630	0.920
St=0.004 at Bi=2					
y \ τ	0.1	0.25	0.5	0.75	1.0
0	0.20	0.38	0.62	0.82	1.0
20	0.18	0.365	0.60	0.79	0.97
40	0.16	0.35	0.58	0.76	0.94
60	0.14	0.333	0.56	0.73	0.91
80	0.119	0.318	0.53	0.70	0.88
100	0.09	0.28	0.50	0.67	0.85
St=0.004 at Bi=20					
y \ τ	0.025	0.05	0.1	0.25	0.5
0	0.19	0.3	0.4	0.68	0.975
20	0.188	0.29	0.39	0.67	0.965
40	0.186	0.28	0.38	0.66	0.95
60	0.184	0.27	0.37	0.65	0.94
80	0.182	0.26	0.36	0.64	0.93
100	0.18	0.25	0.35	0.63	0.918

### Aerodynamics of particles for cooling of blast furnace slag melt drops

The motion equation of a single particle drop of blast furnace slag melt in the straight flow has the following expression [22] for coflowing-downtake, coflowing-uptake and oncoming-downtake cases during processing of gas suspension:

$$m \frac{dv}{dt} = \pm mg - cf_l \rho_g \frac{(v \pm v_g) |v \pm v_g|}{2}, \quad (24)$$

where  $v = dl/dt$  – particle speed;  $v_g$  – gas phase speed;  $c$  – resistance coefficient;  $f$  – gas density for particle cross section;  $l$  – distance of a particle motion;  $m$  – particle mass;  $\tau$  – time;  $g$  – gravity acceleration.

The sign “plus” before  $v_g$  means oncoming motion, the sign “minus” means coflowing motion; the sign “plus” before  $mg$  corresponds to downtake motion, the sign “minus” before  $mg$  corresponds to uptake motion.

When  $v > 50$  m/s,  $d \sim 200$   $\mu\text{m}$ ,  $mg \ll \frac{\rho_s v^2}{2}$  i.e. gravity force can be excluded.

$$m \frac{dv}{dt} = -cf_l \rho_g \frac{(v \pm v_g) |v \pm v_g|}{2}. \quad (25)$$

Calculation error in such equation is within the range 25 %.

If we take dimensionless mode, the motion equation system looks like:

$$\frac{d\bar{v}}{d\bar{\tau}} = -\frac{\text{Re}_g}{16} (\bar{v} \pm 1) |\bar{v} \pm 1|, \quad \bar{v} = \frac{12}{\text{Re}_g} \frac{dL}{d\bar{\tau}} \quad (26)$$

Interaction between distance and speed follows from (26):

$$\frac{d\bar{v}}{dL} = -\frac{3}{4} c \frac{(\bar{v} \pm 1) |\bar{v} \pm 1|}{\bar{v}}, \quad (27)$$

where  $L = \frac{l \rho_g}{\rho_m d_m}$  – dimensionless distance parameter;

$\bar{\tau} = \frac{12 \tau \rho_g v}{d_m^2 \rho_m}$  – dimensionless time parameter;

$\bar{v} = \frac{v}{v_g}$  – dimensionless speed;  $\text{Re}_g = v_g d_m / \nu$  – Reynolds

criterion for gas phase;  $\text{Re}_r = \frac{|v \pm v_g| d_m}{\nu} = \text{Re}_g |v \pm v_g|$  –

Reynolds criterion for relative speed;

After integrating of (31), (33) for spheroid particles at  $c = 24\text{Re}_r^{-1} + 4\text{Re}_r^{-1/3}$ , for coflowing flow at  $v_b = 0, v_e = \bar{v}$ , where  $v_b$  – initial particle speed;  $v_e$  – final particle speed, we shall obtain:

$$\bar{\tau} = \ln \frac{6 + \text{Re}_g^{2/3} (1 - \bar{v})^{2/3}}{(1 - \bar{v})^{2/3} (6 + \text{Re}_g^{2/3})},$$

$$L = \text{Re}_g^{1/3} (1 - \bar{v})^{1/3} + \sqrt{6} \arctg \frac{\sqrt{6} \text{Re}_g^{1/3} [1 - (1 - \bar{v})^{1/3}]}{[1 + \text{Re}_g^{2/3} (1 - \bar{v})^{1/3}]} \pm$$

$$\pm \frac{\text{Re}_g}{12} \ln \frac{6 + \text{Re}_g^{2/3} (1 - \bar{v})^{2/3}}{(6 + \text{Re}_g^{2/3}) (1 - \bar{v})^{2/3}}.$$

For oncoming motion of a melt particle in the flow at  $v_b = \bar{v}, v_e = 0$ .

$$\bar{\tau} = \ln \frac{(6 + \text{Re}_g^{2/3}) (1 + \bar{v})^{2/3}}{(1 + \bar{v})^{2/3} (6 + \text{Re}_g^{2/3})}$$

$$L = \text{Re}_g^{1/3} | (1 + \bar{v})^{1/3} - 1 | - \sqrt{6} \arctg$$

$$\frac{\sqrt{6} \text{Re}_g^{1/3} [(1 + \bar{v})^{1/3} - 1]}{[1 + \text{Re}_g^{2/3} (1 + \bar{v})^{1/3}]} + \frac{\text{Re}_g}{12} \ln \frac{6 + \text{Re}_g^{2/3} (1 + \bar{v})^{2/3}}{(6 + \text{Re}_g^{2/3}) (1 + \bar{v})^{2/3}}$$

For coflowing motion at  $c = \text{const}$ ;  $v_b = 0, v_e = \bar{v}$ :

$$\bar{\tau} = \frac{16}{c \text{Re}_g} \frac{\bar{v}}{|1 - \bar{v}|}; \quad L = \frac{4}{3c} \left[ \frac{\bar{v}}{|1 - \bar{v}|} + \ln |1 - \bar{v}| \right].$$

For coflowing motion of a particle at  $v_b = \bar{v}, v_e = 0$ :

$$\bar{\tau} = \frac{16}{c \text{Re}_g} \frac{\bar{v}}{1 + \bar{v}}; \quad L = \frac{4}{3c} \left[ \ln(1 + \bar{v}) - \frac{\bar{v}}{1 + \bar{v}} \right].$$

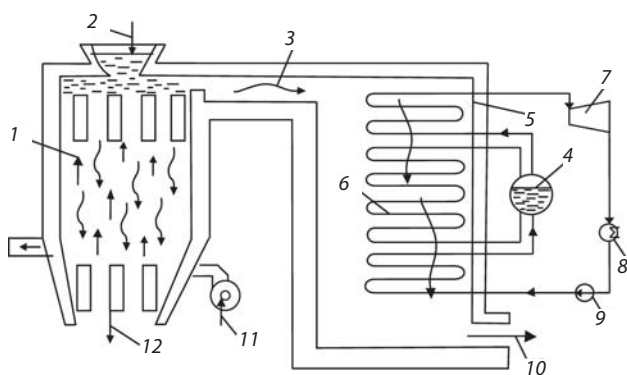
The obtained equations can be used for analysis of particles motion during determination of relaxation time. It should be noted that straight motion is typical for massive particles, and trajectory of such particles in whirled chambers deviates slightly.

Relationship of decay time of the particle relative speed from initial value to zero is presented in the **Table 2** as an example.

Relationship between relaxation time during particle oncoming motion and cooling gas (from one side) and speed and Reynolds criterion (from other side) is displayed. It is natural that increase of gases speed leads to decrease of decay time of the particle speed, and it is necessary to associate

Table 2. Relationship of decay time of the particle relative speed from initial value to zero

$\bar{v} \setminus \text{Re}_g$	$10^4$	$10^3$	$10^2$	10	$10^{-1}$	$10^{-2}$
0.2	$6 \cdot 10^{-4}$	$0.6 \cdot 10^{-2}$	0.15	0.7	0.1	0.15
0.3	$7 \cdot 10^{-4}$	$0.7 \cdot 10^{-2}$	0.25	0.9	0.16	0.2
0.4	$8 \cdot 10^{-4}$	$0.8 \cdot 10^{-2}$	0.30	1.2	0.22	0.25
0.5	$10 \cdot 10^{-4}$	$1.1 \cdot 10^{-2}$	0.40	1.6	0.28	0.35
0.6	$12 \cdot 10^{-4}$	$1.3 \cdot 10^{-2}$	0.60	2.0	0.31	0.4
0.7	$14 \cdot 10^{-4}$	$1.4 \cdot 10^{-2}$	0.70	3.0	0.37	0.42
0.8	$16 \cdot 10^{-4}$	$1.5 \cdot 10^{-2}$	0.75	4.0	0.39	0.44
0.9	$17 \cdot 10^{-4}$	$1.7 \cdot 10^{-2}$	0.80	4.5	0.4	0.5
1.0	$18 \cdot 10^{-4}$	$1.8 \cdot 10^{-2}$	0.88	5.5	0.4	0.5



**Fig. 1. The technological route of slag melt use during air granulation:**

1 – granulator chamber; 2 – slag entering dispersion agent at 1200–1300 °C; 3 – air at ~ 900 °C; 4 – drum of waste heat boiler; 5 – steam superheater; 6 – economizer; 7 – turbine; 8 – condenser; 9 – pump; 10 – to gas cleaning; 11 – air; 12 – slag at 100–150 °C

cooling speed and time of particle presence in solidification area.

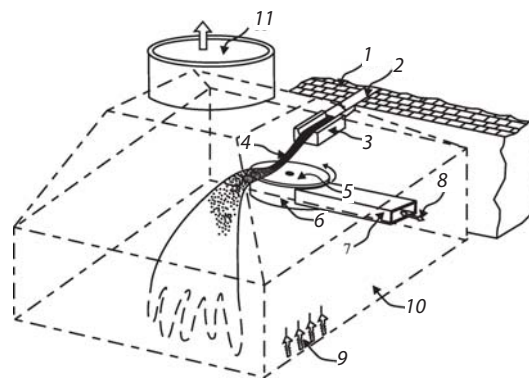
### Analysis of the results

The obtained relationships testify that cooling speed of blast furnace slag melt increases with reducing of their dimension and makes approximately 600 °C/s in the first motion moments for typical diameter 2.5 mm. It is concluded from the analysis, that the time which is required for forming of solid crust on the surface by a blast furnace slag melt particle makes  $\tau = 0.36$  s at the temperature of blast furnace slag crystallization 1423 K. The task of dispersion agent includes forming of such trajectory of a particle motion, when time of its presence in the air medium should not exceed 0.36 s. Trajectory parameters are determined during solving of the gas dynamical problem. The obtained relationships allow to determine granulator dimensions, temperature conditions of equipment operation, hydrodynamic modes of granulation. Designing of energy-saving equipment of such type is very important for realization of closed thermal technological systems, where furnaces with slag technology are used.

### Possible realization of the dry granulation technology

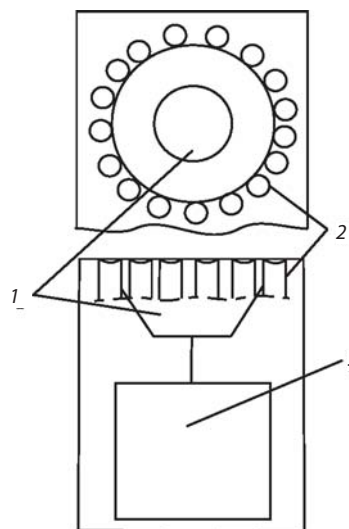
Air granulation of blast furnace slag melt via the route suggested by N.A. Semenko is displayed on the Fig. 1; it occurs inside large hopper, in oncoming flow of cold air which is blown-up from the bottom. Granulated slag is charged from the lower part of a chamber hopper. Cold air in the process of moving up is heated to 800–900 °C (while initial slag temperature was 1200–1300 °C), and then it is used in a drum waste heat boiler with forced circulation of air-steam mix.

Damp steam exits from a separating drum and passing through a steam superheater, is overheated up to 450 °C and is transferred to customers with the pressure up to 4 MPa.



**Fig. 2. The route of melt dispersion (pulverizing):**

1 – furnace bricking; 2 – notch; 3 – runner; 4 – melt jet; 5 – rotating disk or cup; 6 – drive; 7 – cooler of pulverizing unit; 8 – air for cooling of pulverizing unit; 9 – air from granulating chamber; 10 – top part of granulator shell; 11 – inlet case for hot air feed in a power station



**Fig. 3. The route of pulverizing unit with rotating cup:**

1 – cup; 2 – nozzles for pulverized air feed; 3 – drive

It is shown that up to 50 t/h of steam with energetic parameters can be obtained via air granulation of 100 t/h of slag and its cooling from 1300 to 200 °C; this steam amount is sufficient to provide operation of a turbine-type generator with power 10 MWt.

Possible routes of melt dispersion are presented on the Fig. 2 and Fig. 3.

### Conclusion

Possibility of by-furnace dry granulation reduces expenses for blast furnace slag melt utilization, allows to use more completely exergy potential of secondary resources and to obtain additional high-organized energy forms. High-




efficient power-saving variants are achieved e.g. by use of steam turbine-type assemblies.

High exergy potential of blast furnace slag makes it possible to generate electric energy, industrial steam and heating capacities, though such technological routes require corresponding culture of operation.

In this work the following results were obtained.

1. Calculated relationships for evaluation of power exchange and aerodynamics parameters in the process of blast furnace slag solidification in convection flow were found out with taking into account all parameters having influence on the process.

2. The values of technological parameters for analysis of aerodynamic and heat exchange solidification procedures are presented applying to granulation processes of blast furnace slag.

3. Possibilities of optimization of operation modes for power-saving technologies are suggested. 

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