Table 4 **Values of the apparent activation energy determined by the tangent of the slope angle of the direct dependence lg Δt-1/T**

№	Material	The equation	Coefficient of correlation R	Eact / kJ/mol	Temperature range / ° C
1	Nickel briquette (ore + coke)	$\ln\Delta t = -461{,}29 / T + 11{,}21$	0,9904	8,832	130 - 190
		$\ln\Delta t = -2244{,}4 / T + 25{,}27$	0,9136	42,975	610 - 650
		$\ln\Delta t = -474{,}66 / T + 5{,}41$	0,9658	9,088	740 - 840
2	Nickel briquette (ore + coal)	$\ln\Delta t = -66{,}58 / T + 3{,}29$	0,9441	1,274	10 -130
		$\ln\Delta t = -512{,}95 / T + 8{,}98$	0,9707	9,822	300 - 360
		$\ln\Delta t = -301{,}86 / T + 4{,}79$	0,8002	5,780	480 - 600
		$\ln\Delta t = -1780{,}5 / T + 20{,}06$	0,9766	34,093	620 - 700
3	Nickel briquette (ore + AHS)	$\ln\Delta t = -70{,}43 / T + 3{,}34$	0,9433	1,348	20 - 140
		$\ln\Delta t = -1798{,}3 / T + 23{,}5$	0,9999	34,434	480 - 510
		$\ln\Delta t = -277{,}54 / T + 4{,}59$	0,8694	5,314	480 - 700
		$\ln\Delta t = -973{,}81 / T + 9{,}38$	0,9475	18,646	880 - 980

the sample mass by a total of 34 mg. This effect corresponds to the decomposition of the mineral nontronite (Fe, Al) 2 $[Si_4O_{10}(OH]_2 \cdot nH_2O)$. When Gorenje material was heated to 1 080 °C, the fourth and fifth endothermic effects were recorded, characterized by the combustion of solid carbon (at a temperature of 980 °C) with the appearance and establishment of the main components of natural minerals (Fe, Al) $2[Si_4O_{10}\ (OH]_2 \cdot nH_2O$; Fe_2O_3; $FeCr_2O_4$) (at a temperature of 1 080 °C). The total weight loss at these temperatures is 40 mg and 42 mg, respectively.

When considering the DTA curve of the derivatograms of nickel briquette 2 (nickel ore+coal) As you can see in Figure 2 (b), there are a number of effects, which allows you to highlight the most important temperature intervals. The first endothermic effect was observed at a temperature of 130 °C with a mass decrease of 1,25 mg. This effect describes the complete removal of hygroscopic and adsorbed moisture from the coke. Further, at temperatures of 360 °C and 600 °C, the second endothermic and third exothermic effects were observed, corresponding to the burning of volatiles and the decomposition of the serpentine mineral ($3MgO \cdot 2SiO_2 \cdot 2H_2O$). In addition to these transformations, the decomposition of siderite $FeCO_3$ can be observed at a temperature of 560 °C. Total weight loss at these temperatures was 2,5 mg and 5,7 mg, respectively. The fourth endothermic effect at a temperature of 700 °C leads to the beginning of recovery processes with a decrease in total weight by 7 mg. A further increase in temperature to 1 180 °C shows the formation of a fifth weak endothermic effect with a total weight loss of 7 mg. This curve indicates the partial formation of the main phases of minerals (Fe, Al) $2[Si_4O_{10}\ (OH]_2 \cdot nH_2O$; Fe_2O_3; $FeCr_2O_4$).

The derivatogram of a nickel briquette with a silicon-aluminum reducing agent (Figure 2 (c)) shows two endothermic and two exothermic effects that characterize the course of complex physicochemical transformations in the material under study. The first endothermic and second exothermic inflection, which took place at temperatures of 140 °C and 510 °C, were responsible for the removal of hygroscopic moisture from the ore and the release of structured moisture with a total weight loss of 23 mg and 30,5 mg, respectively. The third pronounced endothermic effect (at a temperature of 700 °C), apparently, corresponds to the rearrangement of the lattices of the intermetallides of the silicon-aluminum reducing agent with a weight loss of up to 32 mg. An increase in temperature to 980 °C leads to an increase in the DTA curve (steep maximum) of the fourth exothermic effect, corresponding to the beginning of the interaction of the ore with the reducing agent and the oxidation of the silicon-aluminum reducing agent with air oxygen. In addition, calculations were performed to determine the values of the temperature values and the deviation of the DTA curve (obtained by processing the DTA curve) from a given direction (Table 4).

CONCLUSION

The analysis of the temperature maxima and the level of the activation energy of the processes accompanied by peaks on the DTA curves of the casted nickel ores suggests that the diffusion processes occurring during heat treatment and responsible for the solid-phase hardening of sintered materials with the participation of nickel ore and reducing agents occur under more favorable conditions. Therefore, it can be concluded that the processes occurring during the heat treatment of nickel ore with different mixtures proceed at a sufficiently high speed and reach a high degree of completion at firing temperatures.

Thus, the results obtained allow us to orient ourselves in the rate of interaction reactions during the smelting of a nickel-containing alloy in industrial furnaces [14, 15]. Since nickel-containing briquettes have a low value in terms of activation energies (Table 4).

REFERENCES

[1] Mashchenko V. N., Kniss V. A., Kobelov V. A., Avdeev A. S., Polyansky L. I. Preparation of oxidized nickel ores for smelting. - Yekaterinburg: RAS, 2005. -324 p.

[2] Tolymbekova, L. B., Kim, A. S., Zhunusov, A. K., Babenko, A. A. Thermal transformations in manganese ores in the zapadnyi kamys deposit and in charge materials used