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THERMAL ANALYSIS OF CARBON ANTI-BURN-ON DISPERSE SYSTEMS USED IN FOUNDRIES

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Anti-burn-on disperse systems for foundry use, containing carbon (graphite or anthracite after different pretreatments, or mixtures thereof) in carboxymethylcellulose-water, were studied by TG–DTA. Thermal effects are attributed to the evaporation of water, the evolution of other volatiles and the beginning of ignition. TG is useful for determination of the water content.

Anti-burn-on disperse systems (suspensions) are widely used in foundries. They contain graphite, talc, bentonite, coke and different binding substances (carboxymethylcellulose, molasses and others). For this purpose, Maslov and Petrenko [1] recommended the following composition (%): silvery graphite, 10 to 20; talc, 33 to 60; refractory clay, 4 to 6; sulphite lye, 8 to 12; and carboxymethylcellulose, 15 to 35%. There are several Bulgarian patents for similar suspensions [2–5]. Ruschev et al. [6] attempted the partial or total replacement of graphite in anti-burn-on water disperse systems with anthracite, carbon concentrate and other carbon materials.

Hao Lin [7] and Ruschev and Atanasov [8] investigated disperse systems containing solid and liquid fuels, and found that the DTA curve depends mainly on the dispersing medium and to a much smaller extent on the dispersed phase, in this case carbon. In the thermal analysis of fuel suspensions from carbon concentrate, liquid paraffin and mazut (black-fuel oil, oil residue), Ruschev et al. [9] showed that fuel disperse systems start to evolve volatile products above 160° and possess a higher tendency to reaction in comparison with carbon concentrate, the thermal destruction of which takes place at above 500°.

The present investigations were conducted with some anti-burn-on water disperse systems, the compositions and main properties of which are given in Table 1. Thermal analysis was performed with an OD–102 derivatograph (MOM) under the following conditions: heating rate 10 deg min^{-1}, inert substance Al_2O_3; sample mass 400 to 500 mg, uncontrolled air atmosphere. DTA and TG curves of the investigated water disperse systems are given in Fig. 1. The DTA curves start with a large endothermal effect with its maximum in the temperature interval from

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Table 1 Composition and properties of carbon- anti-burn-on water disperse systems

Components and indices	Compositions, %				
	I	II	III	IV	V
Black graphite	22.0	—	11.0	11.0	11.0
Anthracite ASH	—	22.0	11.0	—	
Anthracite ASH heated to 500 °C	—	—	—	11.0	—
Anthracite ASH heated to 1000 °C	—	—	—	—	11.0
Carboxymethylcellulose	2.0	2.0	2.0	2.0	2.0
Water	76.0	76.0	76.0	76.0	76.0
Density, g cm^{-3}	1.16	1.10	1.06	1.09	1.12
Viscosity, s	35	24	17	18	19
Stability, %					
after 1 h	100	100	91	97	99
after 24 h	96	95	60	73	79
Stability of wear, kg mm^{-1} 10^3	above	133.6	57.9	58.3	59.4

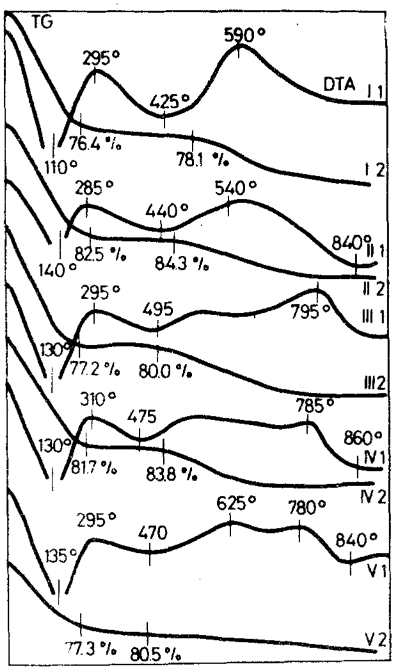

Fig. 1 DTA and TG-curves of carbon anti-burn-on water disperse systems, composition is shown in Table 1
I – graphite, II – antracite, III – graphite–antracite, IV – graphite–thermoantracite (500 °C), V – graphite–thermoantracite (1000 °C)

110 to 140° ; this is due to the evaporation of the dispersing medium (water), which continues to be evolved up to 160–190°, during which the mass decreases by 76.4–82.5%. These results show that, through the loss in mass during the thermal analysis, the quantity of water can be determined exactly from the first fall in the TG curve of the anti-burn-on disperse system.

Small additional amounts of volatile products (2 to 3%) are evolved from 200 to 460–495°, causing only one characteristic endotherm effect at 425, 440, 475 or 495°, respectively. Above 550°, the remainder of the volatile substance is evolved, which is extremely low in the disperse systems containing anthracite heated to 1000° (Fig. 1, curve V). In this temperature interval, some further exothermic effects are registered at 590, 785, 795 and other temperatures, which probably result from the partial ignition of solid disperse phase (graphite and anthracite).

Conclusions

1. Thermal analyses were performed on 5 different carbon anti-burn-on disperse systems, which contain graphite (11 and 22%), anthracite type ASH (11 and 22%), thermoanthracite obtained at 500 and 1000° (11%), carboxymethylcellulose (2%) and water (76%).

2. It was found that the DTA curves of these suspensions start with a large endothermal effect with its maximum in the temperature interval from 110 to 140° ; this is due to the evaporation of the dispersing medium, which is totally evolved up to 160–190°. From the fall in the TG curve, the water content in the anti-burn-on disperse system can be determined.

3. From 200° to 500°, the DTA curves of the carbon-water anti-burn-on disperse systems exhibit only one small endotherm effect and some exotherm effects at 590, 785, 795 and other temperatures.

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Zusammenfassung — Oxidationshemmende Dispersionen für die Giesserei, die aus Kohle (Graphit, Anthrazit verschiedener Vorbehandlung bzw. Gemische daraus), Carboxymethylcellulose und Wasser bestehen, wurden durch TG–DTA untersucht. Die thermischen Effekte werden der Verdampfung von Wasser, dem Entweichen anderer flüchtiger Produkte und der beginnenden Verbrennung zugeordnet. Der Wassergehalt kann mittels TG bestimmt werden.

Резюме — Углеродсодержащие системы (графит, антрацит и их смеси с разной предварительной обработкой), используемые в литейном производстве в качестве антинаварных добавок, были изучены методом ТГ—ДТА в виде дисперсий в системе карбоксиметилцеллюлоза — вода. Термические еффекты обусловлены испарением воды, выделением иных летучих продуктов и началом горения. Метод ТГ пригоден для определения содержания воды.