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Investigation of influence of bound amount in the composition of briquette- modificators

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Abstract
The analysis of main factors, which form briquette- modificator properties and their modulating effect, is fulfilled. Series of experiments concerning the study of influence of organic bound amount on decomposition of briquette and connected with this time for its dissolving are fulfilled. Practical content of organic bound in the briquette, which influences positively on the time for briquette dissolving, is determined.
Key words: BRIQUETTE- MODIFICATOR, MODIFICATION, DESTRUCTION, BOUND, TEMPERATURE

Introduction and problem statement

Over the last years there is a tendency to apply modificators in the form of briquettes obtained by means of materials pressing [1, 2]. To the modified briquette there specified some requirements, which are different from the ones, specified for briquette used for burdening in melting units: briquette should remain undamaged while transporting, but during introduction into smelt it should fracture, creating great amount of crystallization centers.

While briquetting of powdered materials there widely used nonorganic bounds: concrete of various types, refractory clay, liquid glass, aluminium-chromium-phosphate bounds [3,4]. Such bounds provide high impact mechanical strength of briquettes, but effectiveness of their usage reduces because of reduction of density of modificators in them and the degree of their effective recovery by smelting [3, 4]. Besides, synthesis of such briquettes requires high energy consumption not only for briquetting, but for annealing, minimal temperature of which exceeds 500^{o} C.

Aim of the work

The aim of the work is to study the possibility of speeding of briquette destruction process in smelting, connected with its composition.

As an alternative to nonorganic bound we used organic ones, which are the products of mill waste ("meal"), sugar production (molasses solution), etc [5-7]. Such bounds are natural polymers, which while heating (at the temperature more than 120…140 ^{0}C) turn into dextrines filling the pores between particles, connecting them. Advantage of organic bounds is their rapid burn out from the briquette in smelting, exceeding its decomposition and not fouling the smelt.

Basic material

Analysis of information [1-5] allowed to reveal main factors, which form the properties of briquette- modificators and their modifying effect: moulding conditions, sizes, briquette composition. In the earlier fulfilled experiments there were not investigated the influence of organic bound within the briquette on the technological factors of its behavior in smelting. There fulfilled some experiments concerning the study of influence of amount of organic bound on the briquette decomposition and connected with this time of its dissolving.

The peculiarity of briquette- modificators with organic bound is thermal decomposition of the last under the influence of smelting temperature, which coincide in the time with initial stage of solution process.

Thermal decomposition of organic bound [8] is the process, arising in time, in result of which there is removal from briquette body some of its substance due to gasification with further burn out. In result of such decomposition there occurs exudation on the briquette surface of additory heat carrier in such a manner that on the contact surface "briquette-smelting" the temperature increases, which contributes to intensification of dissolving of surfaces of briquette part. Depending on the type of applied organic bound there are two variants of extension of the process of briquette decomposition:

- rapture of briquette body under the action internal pressure connected with gas emission from the briquette;
- space liberation in the briquette, which is occupied by the bound (due to its gasification), which lead to increase of porosity in briquette and therefore cut of time for briquette solution because of smelt entering into the pores.

It is found that the first variant of decomposition is realized under the condition when caloric power of the bound is higher than the one of filler. The second variant is realized under the condition of developed specific surface area of the briquette, which depends on the way of briquette production (vibro-pressing or pressing in roller press).

As organic bound in experimental briquettes there were used products of mill waste, which are natural polymer with content of amylum up to 70%. In the process of heating (at the temperature more than 180…200^{0}C) amylum converts into dextrin, which fills pores between particles. Dextrinization of amylum during heating is followed by increase of its solvability due to formation of simple polysaccharides of smaller molecular mass. Among the substances, being a part of the bound, there are also nitrate and acetous ethers, which are the products of interaction of hydroxyl groups with acid natural environment (diacetate, triacetate, ternitrate). Common quality of such ethers is their extra-high reactive capacity, which provides high caloric power of organic bound.

To determine reasonable variant of briquette decomposition with suggested composition there was fulfilled an experiment. Briquettes of cylindrical form Ø 30x15 mm, which are made of: nanopowder TiCN (35...40%), organic bound (4…5 %), dispersive Al (3…5 %) and the rest is dispersive pig iron cuttings, were placed into electric furnace, which provides exclusion of errors connected with trapping of burn out fuel gases. Gas analyzer with thermal couple for determination of waste gas composition during heating of briquette depending on the temperature is supplied to furnace offtake. While experiment there was used dry method, i.e. heating of briquettes was fulfilled simultaneously with furnace without interaction with metal. According to results fixed by gas analyzer there was built dependence graph of gas output from the briquettes on the temperature (fig.1).

One may see from the graph that the most intensive gasification of the briquette is observed at the early stages of heating.

In result of fulfilled experiments there found out that formed while briquette heating gases do not lead to its decomposition, but contribute to bubling of smelting, which gives equilibrium distribution of modificator, which came free, along the volume of smelting. In such a way, decomposition of investigated briquettes is fulfilled due to burn out of bound and filling of formed pores. In this basis one may suppose that increase of bound amount affects positively the time for briquette solution. Whereby the increase of organic bound content from 5 to 30% in the briquette contributes the decrease of time of briquette solution in 1.6 times. Further increase of content of organic bound up to 40, 50% does not lead to time cut for briquette solution, which points on the non-effectiveness of increase of its content in briquette composition more than 30% as this will

lead to increase of amount of introduced briquettes for achievement of desired effect of modifying and to extra charges.

Conclusions

During research there was found out that gases formed while heating of briquette (CO_2, CO, CH_4, NO_x, H_2, C_mH_n) does not lead to its decomposition. Fulfilled experiments showed that summary limit values of gas content, which is released while briquette heating , reduce; this speaks for finiteness of kinetics process of modifying.

Kinetics of modifying is entitled to follow-up study; i.e. time between process of modificator supply into smelting and ending of its recovery.

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