Dear Editors and Reviewers:

On behalf of my co-authors, we thank you very much for giving us an opportunity to revise our manuscript, we appreciate editor and reviewers very much for your positive and constructive comments and suggestions on our manuscript entitled “Study on mineralogical crystallization of granulation of gas quenching blast furnace slag”. We have studied comments carefully and have made correction which we hope meet with approval. Revised portion are marked in red in the paper. The main corrections in the paper and the responds to the reviewer’s comments are as follows:

Reviewer A:

Thanks for your positive affirmation of our manuscript.

Reviewer B:

Thanks for your constructive comments and suggestions on our manuscript.

1: The part concerning theoretical consideration should be clearly departed from the Experimental section, for example: in paragraph Experimental method authors stating “Thermodynamic simulation…”.

Response 1: The part concerning theoretical consideration has been clearly departed from the Experimental section in the paper which are marked in red in page 3.

2: Remelting experiment should be given in more details and XRD and SEM analyses as characterization techniques are not mentioned at all in Experimental section (which devices, conditions etc.).

Response 2: The remelting experiment has been written in more details and the devices and conditions of XRD and SEM analyses as characterization techniques have been mentioned in the paper which are marked in red in page 3, and the revised portion are as fol lows:

*Remelting experiments*

Remelting experiments are carried out with high temperature LMC directional solidification cooling equipment, which can make the 50g sample arise from room temperature to 2073K. The samples placed in the crucibles are prepared according to the Table Ⅱwith analytical reagent of CaO, SiO2, MgO and Al2O3 and the samples are dried 6h at 383K in the air dry oven. The temperature control program is set as follows: the heating rate is set at 25K/min and lasts for 63min to improve the temperature from room temperature to 1873K in the heating period. In the constant temperature period, the temperature remains constant under 1873K and lasts for 60min to make samples remelt completely. In the cooling period, the BFS losses large amount of sensible heat and the gas quenching temperature is about 1623K in the gas quenching process, the cooling rate is set at -1K/min and declines the temperature from 1873K to 1623K. In the second constant temperature period, the furnace remained 1623K for 120min to guarantee to reach thermodynamic equilibrium. Finally, the samples are quickly immersed into water to quench the sample to reserve the mineral phase at target temperature.

*XRD analysis*

The samples are grinded with a grinding prototype (ZHM-1-P03061808), and the elemental composition of the samples are measured on a X-ray diffractometer (D/MAX2500PC), which use Cu Kα radiation operated at 40kV and 100mA. All the diffraction profiles are obtained in continuous mode at the scan speed of 10°/min.

*SEM analysis*

The samples are prepared by the polishing equipment (Vibromet 2), and then the samples are evaluated by a Field Emission Scanning Electron Microscope (S-4800), which can directly observe the surface microstructures of the sample.

3: In Table 1. are not given chemical compounds but chemical composition and how this composition was determined it is not known.

Response 3：We are very sorry for our negligence in writing the composition into the compound, that it has now been corrected in the Table 1. which are marked in red in paper.

4: The part concerning the influence of content of certain oxides and basicity on crystallization temperature was not explained in a sence why this particular interval of oxide content and interval of basicity? Does these results can be applied somewhere?

Response 4: On the basis of the original composition of blast furnace slag, the additive amount of conditioning agent is reduced as much as possible to ensure the full utilization of blast furnace slag, to fully recover the waste heat of blast furnace slag, and to improve the added-value of blast furnace slag. So adjusting the oxide content and basicity according to the article. We have added the reason in the *Experimental Materials section* in page 2. These results can be applied in the process of gas quenching of blast furnace slag to produce the high performance and amorphous phase of glass beads.

5: Figures presenting evolution of phases as a function of temperature for the investigated system meaning, Figs. 2., 4., 6., 8., should contain captions with all the necessary information so the figures can be investigated solely.

Response 5: The Figs. 2., 4., 6., 8., have been modified with all the necessary information and the titles are marked in red in paper.

6: Other figures representing three-component phase diagrams are small and not easy to read and to recognize the certain composition interval of interest.

Response 6: Other fingers representing three-component phase diagrams have been adjusted and revised accordingly, whose titles are marked in red in paper.

7: All the discussion should be organized in a manner that it is not simply “reading the figures data” on phases evolution, but make a different structure of discussion, make some parallel, draw some conclusions explicitly, because it is really without sense to read the percentages and temperatures over and over again after each figure that authors gave.

Response 7: We have adjusted and organized the discussion section again and the modified content has been marked in red in paper.

As shown in fig. 2 that the mililite minerals (Mel\_) crystallized at 1698.3K firstly, and the spinel（SPINA）and anorthite (Ca3Al2Si2O8) crystallized gradually with the temperature decreased. The crystallization temperature of the BFS increased from 1698.3K to 1892K with the basicity increased. The initial crystallization phase of BFS was transformed from mililite minerals to α-C2S when the basicity increased to 1.1 and because of the instability of the α-C2S, it transformed until disappeared with the decrease of temperature. The increase of basicity retrained the crystallization of mililite minerals and anorthite, and promoted the crystallization of manganolite and α-C2S. In summary, the increase of the basicity of BFS promoted the crystallization of high melting point minerals, which led to the increase of crystallization temperature and the change of initial crystallization phase of BFS, so the large amount of crystallization of mineral phase was not conducive to the production of amorphous BFS beads. In order to further understand the effect of basicity on mineral phase, the phase diagram of BFS was drawn by FactSage 7.1, which was shown in fig. 3.

As shown in fig. 4 that the melilite minerals (Mel\_) crystallized at 1698.3K firstly, and the spinel (SPINA) and anorthite (Ca3Al2Si2O8) crystallized gradually with the temperature decreased. The crystallization temperature of the BFS decreased from 1698.3K to 1581.4K with the acidity increased. The pyroxenes minerals (cPyrA#1) and calcium silica minerals (WOLLA) crystallized and spinel disappeared when the acidity increased to 1.3. The increase of acidity retrained the crystallization of mililite minerals and anorthite, and promoted the crystallization of pyroxenes minerals and calcium silica minerals. In summary, the increase of the acidity of BFS retrained the crystallization of high melting point minerals, which led to the decrease of crystallization temperature, and the decline of the crystallization amount was conducive to the production of amorphous BFS beads which realized the comprehensive utilization of BFS resources. In order to further understand the effect of acidity on mineral phase, the phase diagram of BFS was drawn by FactSage 7.1, which was shown in fig. 5.

As shown in fig. 6 that the crystallized minerals were melilite minerals (Mel\_), spinel (SPINA) and anorthite (Ca3Al2Si2O8) after adding the conditioning agent of MgO. The crystallization temperature of BFS decreased slightly, and the initial crystallization phase changed from melilite minerals to spinel with the increase of the content of MgO. In summary, The crystallization amount of melilite phase was almost unchanged, and the increase of the content of MgO promoted the crystallization of spinel and restrained the crystallization of anorthite phase. In order to further understand the effect of MgO content on mineral phase, the phase diagram of BFS was drawn by FactSage 7.1, which was shown in fig. 7.

As shown in fig. 8 that the crystallized minerals were melilite minerals (Mel\_) , spinel (SPINA) and anorthite (Ca3Al2Si2O8) after adding the conditioning agent of Al2O3. The initial crystallization phase were melilite minerals and the crystallization temperature of BFS increased slightly with the increase of the content of Al2O3 . In summary, the increase of the crystallization temperature restrained the crystallization of the melilite phase and promoted the crystallization of spinel and anorthite with the increase of the content of Al2O3 in BFS. In order to further understand the effect of Al2O3 content on mineral phase, the phase diagram of BFS was drawn by FactSage 7.1, which was shown in fig. 9.

We tried our best to improve the manuscript and made some changes in the manuscript. These changes will not influence the content and framework of the paper. And here we did not list the changes but marked in red in revised paper.

We appreciate for Editors and Reviewers’ comments and suggestions, and hope that the correction will meet with approval.

With regards

KANG Yue