Accepted Manuscript

Effects of calcination on silica phase transition in diatomite

Renji Zheng, Zijie Ren, Huimin Gao, Anling Zhang, Zheng Bian

PII: S0925-8388(18)31688-8

DOI: 10.1016/j.jallcom.2018.05.010

Reference: JALCOM 45983

To appear in: *Journal of Alloys and Compounds*

Received Date: 6 December 2017

Revised Date: 15 April 2018

Accepted Date: 1 May 2018

Please cite this article as: R. Zheng, Z. Ren, H. Gao, A. Zhang, Z. Bian, Effects of calcination on silica phase transition in diatomite, *Journal of Alloys and Compounds* (2018), doi: 10.1016/j.jallcom.2018.05.010.

Effects of calcination on silica phase transition in diatomite

Renji Zheng [a], Zijie Ren [a, b, *], Huimin Gao [a, b], Anling Zhang [a], Zheng Bian [a]

[a] *School of Resources and Environmental Engineering, Wuhan University of Technology, Wuhan 430070, China; zrjdr0214@whut.edu.cn (R. Zheng); gaohuimin1958@126.com (H. Gao); zhanganling@whut.edu.cn (A. Zhang); 2221048569@qq.com (Z. Bian)*

[b] *Hubei Key Laboratory of Mineral Resources Processing & Environment, Wuhan 430070, China*

***** *Corresponding author. E-mail address: renzijie@whut.edu.cn (Z. Ren)*

Abstract: Calcination has been a major means for the preparation of diatomite filter aids because it improves the permeability of filter aids. However, the pore structure and silica phase of diatomite could be destroyed or altered during thermal processing, which seriously restrains the properties of diatomite filter aids. In the present work, the calcination of diatomite was carried out to investigate its effect on silica phase transition in diatomite. Diatomite with a certain particle size distribution as raw material was sintered in a muffle furnace at a temperature from 200 ℃ to 1200 ℃ with or without flux (7 wt.% $NaCO_3$). The phase evolution and microstructure of diatomite were investigated by thermal analysis (TG and DSC), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), and transmission electron microscopy (TEM). The results showed that the opal in diatomite began converting to cristobalite at 1000 ℃ without flux and the transformation temperature was reduced by 200 ℃ by adding flux. In addition, there was about 64.02% content of quartz in diatomite converting to cristobalite as the calcination temperature increased from 1100 ℃ to 1200 ℃ by flux calcination. It was considered to be a universal phenomenon that the opal in diatomite transformed into cristobalite under high-temperature calcination due to their similar microcrystalline structure. Furthermore, the quartz in raw diatomite was inclined to transform into cristobalite rather than tridymite, mainly owing to the existence of crystal nucleus of cristobalite formed from opal-cristobalite phase transition. The findings in this paper improve understanding of silica phase transition in diatomite upon calcination.

Keywords: Calcined diatomite; Flux calcination; Silica phase; Phase transition.

1. Introduction

Diatomite is a type of porous silicate material composed of the skeletal remains of single-cell water plants (algae) with a chemical formula of $SiO_2 \cdot nH_2O$ [1], the main phase of which is opal, and it belongs to amorphous silica. Diatomite has been used in a number of applications, especially in the filter aids industry, for its high permeability, high porosity, low thermal conductivity, and chemical inertness [2–4]. In addition to the application in filtration, diatomite has also excelled in dye removal due to its large specific surface area and high adsorption capacity, and it possesses good adsorption properties, especially for oils and microorganisms [5–7]. In China, there are abundant diatomite resources, but most of them only have a SiO_2 content of about 60%–80%, which limits the commercial utilization of diatomite in industrial productions or applications [3,8]. Therefore, most raw diatomite needs to be treated by calcination or flux calcination for purification to remove the organic matter and carbonate compounds within [9]. In addition, calcination could further improve permeability, whiteness, and other distinctive features of diatomite filter aids [10].

However, calcination is not always a perfect process for diatomite because the desired porous structure of diatomite would be destroyed, which would seriously restrain the properties of