

REGULAR NOTES

SURFACE MODIFICATIONS OF VOLCANIC GLASSES (PERLITES) BY WATER VAPOR

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Abstract— Hydrothermal treatments on expanded volcanic glasses (perlites) were studied. The main objective of this paper is to obtain an activated surface able to interact with specific chemical substances. The above mentioned treatment consists on exposing the glass surface to water vapor at temperatures over 250°C at the correspondent vapor pressure during different periods of time and for different size of particles. The glass surface modifications were studied by IR, DTA-TG and adsorption techniques. The grade of surface activation was tested by studying the chemical interaction with polysiloxane polymers.

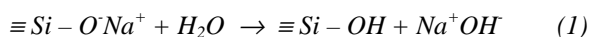
Keywords— glasses, surface modifications, perlite.

I. INTRODUCTION

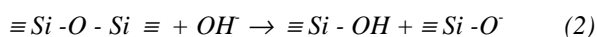
Amorphous materials, specially natural and synthetic glass have found a wide spectrum of practical applications as follows: polishing-free optical lenses, adsorbents, chemical species supports, like molecular sieves, ligand transport, biochemical, etc. (Moriya and Nogami, 1983).

The low superficial reactivity of this kind of materials is limited for its applications. However the superficial reactivity can be increased by different treatments. Hydrothermal treatments are adequate for expanded perlite. A hydrated glass with the characteristic of having OH groups on the surface is obtained by the exposure of expanded perlite to water vapor (Batholomew, 1980).

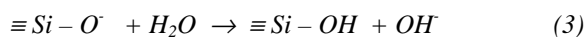
As reported in the literature (Goyal and Cutler, 1975; Abalos *et al.*, 1995), when the water vapor comes in contact with the soda-lime glass the following process takes place:



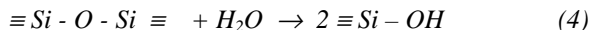
A free hydroxyl ion is formed in the hydrolysis reactions and a second important step in the glass corrosion takes place:



In reaction (2) the very strong bond (Si-O-Si) is broken and gives rise to another active group, which reacts with water as:



The overall reaction may be written as:



The OH groups on the surface can interact with special chemical groups, like organic polymers, in order to form materials useful in separation and adsorption technologies, for example. To make the above concept viable for an industrial process, the presence of hydroxyl groups in the glass surface as a function of vapor pressure and temperature must be investigated.

It is the aim of this work to present the results obtained from incorporating hydroxyl groups into a glass surface and the test of the materials obtained with polydimethylsiloxane.

II. EXPERIMENTAL

A. Material Description

Perlites are volcanic hydrated glasses, which are able to expand when exposed at high temperatures. Hydration water is eliminated during this expansion process. The obtained material is called “expanded perlite” with characteristics like low-chemical reactivity, porosity and mechanical resistance.

Chemically, perlites are glasses with a high silicon and alkali content (Destefanis *et al.*, 1987). The bulk chemical composition of the material is shown in Table 1:

TABLE 1. Expanded Perlite Chemical Composition (%mole)	
SiO ₂	75.36
TiO ₂	0.20
Al ₂ O ₃	13.85
Fe ₂ O ₃	0.67
FeO	0.00
MnO	0.08
MgO	0.29
CaO	1.07
Na ₂ O	3.58
K ₂ O	4.84
P ₂ O ₅	0.04
TOTAL	99.98

B. Materials Preparation

B1. Rehydroxilated perlite:

A fraction 14-18 US series (1.168-0.991mm) of green perlites was expanded at 1000°C during 5 minutes in an electric oven. The resultant material was separated in fractions of different size and these were rehydroxilated. The rehydroxilation process consists in exposing the solid to water vapor in a Parr High Pressure Reactor Model 4652. The experiences were carried out over a range of 250 to 320°C, 30 to 110 Kg/cm² of pressure, during different periods of time.