PROCESS FOR MANUFACTURING GRANULAR FOAMED PRODUCTS OF SILICA

This invention relates to a process for manufacturing granular foamed products of silica which have a lightweight property and excellent mechanical strength and chemical resistance.

Inorganic lightweight foamed products have heretofore been well-known which are prepared by foaming natural minerals through firing. Also known are some inorganic foamed products prepared from artificially made materials. The properties of a foamed product obtained by firing a natural mineral are determined substantially by the properties of the natural mineral used. Further in the case of a foamed product prepared from an artificial material, it is at present difficult to change the characteristics of the product determined by the manufacturing process.

The present inventors have carried out researches to develop a process for manufacturing an inorganic lightweight foamed product by which the properties of the resulting product can be altered as desired, depending on the uses thereof.

It is well known that silica gel is excellent in noncombustibility and heat resistance, is stable chemically, and has large specific surface are and high hygroscopicity. It is employed as a catalyst carrier, dehumidifying agent and applied to like uses wherein these characteristics are utilized to advantage. However, because of excessively high hygroscopicity, silica gel has the drawback that in the presence of water or moisture it quickly absorbs water to break by itself, this rendering it serviceable only in a limited range of application. Foamed products from silica gel which are no longer hygroscopic, are noncombustible, resistant to heat, chemically stable and much more lightweight than silica gel have been produced. In preparing foamed products of this type from silica gel, the starting material is heated and foamed under specific firing conditions. This process was filed as U.S. patent application Ser. No. 92,150 on Nov. 23, 1970 and patented under U.S. Pat. No. 3,717,486 on Feb. 20, 1973.

However, the products obtained by this method still have some properties to be improved. For example, chemical resistance, particularly alkali resistance, is not sufficient in some uses. Further, other properties, such as mechanical strength and heat resistance are also desired to be improved in accordance with the uses of the products.

An object of the present invention is accordingly to provide an improved process for manufacturing foamed products of silica, which are not only lightweight and no longer hygroscopic but also excellent in chemical resistant property, particularly alkali resistant property.

Another object of the present invention is to provide a process for manufacturing foamed products of silica, whereby mechanical strength of the products is increased markedly.

Another object of the invention is to provide a process for manufacturing foamed products of silica which have improved and excellent heat resistance.

These and other objects of the invention will be apparent from the following description.

The process for producing foamed product of silica in accordance with the present invention comprises adding water-insoluble inorganic powder having a particle size of 0.05 to 100μ to a silica sol to produce a uniform mixture, gelling the resulting mixture at a pH of not higher than 7 to produce hydrosilica gel, drying the gel obtained to remove sorbed water and firing the dried silica gel at 1000° to 1600°C to effect foaming, said water-insoluble inorganic powder being stable under the gelling condition of silica sol and infusible, not decomposable and nonvolatile during the firing step.

According to the researches of the present inventors it has been found that when water-insoluble inorganic powder having the above properties is added to a silica sol and the silica gel obtained by gelling the mixture at a pH of not more than 7 is fired after drying, a foamed product of silica having greatly improved properties can be obtained without deteriorating foaming properties. The foamed product obtained by the present invention is not only lightweight and no longer hygroscopic but also has a high order of mechanical strength and excellent chemical resistance, particularly alkali resistance. In accordance with the present process it is possible, moreover, to improve various properties of the resulting foamed products, such as heat resistance, depending on the kind of inorganic powder to be used.

Generally employable as the starting material in the present invention is silica sol which is produced by the conventional method as by neutralization of water glass with acid such as hydrochloric acid, sulfuric acid, nitric acid, acetic acid, oxalic acid, etc. The water glass to be used has preferably a molar ratio of Na_2O/SiO_2 of between 1 : 1 and 1 : 4 and a solid concentration of 5 to 40% by weight. The neutralization of water glass is preferably carried out by pouring the water glass into an excess amount of acid to produce a silica sol having a pH of not higher than 7.

According to this invention , it is critical to use a water-insoluble inorganic powder as the powder to be added to silica sol. By the use of water-insoluble powder chemical resistance and other properties of the products can be improved, whereas if the powder is water-soluble no improving effect on the properties of the product can be attained. Generally, the powder having a particle size ranging from 0.05 to 100 μ is used in the invention. If the particle size is too great, it is difficult to disperse the powder uniformly in silica gel, with the resulting tendency that it becomes difficult to obtain a uniformly foamed product. Preferably particle size is in the range of 0.1 to 10 μ. It is further required that the powder be stable under the gelling conditions for silica sol and infusible, nondecomposable and nonvolatile under the firing conditions. If it lacks one of the above properties the improving effect on the properties of the resulting products can not be attained.

Examples of the inorganic powder are powders of (1) ceramic raw materials, (2) metal oxides other than alkali metal oxides and (3) compound oxides of metals other than alkali metals. The ceramic raw materials include, for example, (a) siliceous minerals, such as, siliceous stone, silica sand, diatomaceous earth, pottery stone, etc.; (b) clay minerals, such as kaolin, acid clay, pyrophyllite, etc.; (c) aluminous minerals, such as, boehmite, gibbsite, bauxite, aluminous shale, etc.; (d) siliceous bittererdes, such as, talc, peridotite, serpentine, asbestos, etc.; (e) iron minerals, such as, iron ore, ocher, pyrite, chlorite, red mud, etc.; (f) titanium minerals, such as, ilmenite, rutile, titanite, etc.; (g) manganese minerals, such as, pyrolusite, rhodomite, etc.; (h)