United States Patent Office 3,719,510
Patented Mar. 6, 1973

3,719,510

PREPARATION OF EXPANDED SILICATE-BASED AGGREGATES

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No Drawing. Filed Sept. 29, 1971, Ser. No. 184,943
Int. Cl. C04b 31/02
U.S. Cl. 106—40 1 Claim

ABSTRACT OF THE DISCLOSURE

A process is provided for the preparation of an expanded insoluble aggregate from a mixture of aqueous and anhydrous alkali metal silicates, having weight ratios of 1:3.0–7.0, with primary and secondary insolubilizers. The anhydrous silicate is added to obtain a silicate solids content within the range of 80–40 percent. After mixing and curing, the composition is ground to a particulate form and subsequently expanded at temperatures in excess of 800° F. The primary insolubilizer, e.g., sodium silicofluoride, serves to reduce the hygroscopicity of the ground particulate material prior to expansion, while the secondary insolubilizer, e.g., calcium carbonate, reacts at expansion temperatures to provide an insoluble lightweight aggregate.

BACKGROUND OF THE INVENTION

It is known to produce porous cellular bodies by the rapid thermal expansion of materials, including silicates, which contain a liquid acting as a blowing agent. Such expanded bodies exhibit excellent thermal and acoustical insulating properties and have been used as, or in a variety of, materials of construction, e.g., concrete fillers, loose insulation, wallboard manufacture, protective coatings and the like. Many of these expanded bodies have been based on alkali metal silicates, owing to their relatively low cost and the excellent physical properties obtainable therewith. Wallboard has been prepared, for example, by the formation of a plastic silicate-containing mass between paper liners followed by thermal expansion. Also, granules of silicate have been expanded at high temperatures to form popcorn-like materials which are useful as is for many insulation-related applications.

A difficulty early noted with the silicate-based materials was their deterioration after exposure to moisture for extended periods of time. With the in situ expanded wallboard it is not possible to subject the core of the board to sufficiently high temperatures to complete the expansion. Hence the low moisture resistance, as well as less than optimum insulating properties. With the granular material, while high temperatures insure complete expansion, the problem of solubility remains. Many attempts have been made to insolubilize these silicate-based materials, most following the theme of subsequent application of an insolubilizing agent, either by coating the expanded body or causing a chemical reaction resulting in the formation of insoluble silica. Obviously, such treatment involves additional steps in the process for obtaining the expanded body, while results are still not entirely satisfactory.

A further problem with the production of silicate-based expanded materials is that, if a workable mass is to be provided, that is, one that will remain in a pattern or which may be ground, it is necessary to increase the viscosity of the aqueous silicate. Commonly, this is done by the addition of various precipitants. However, these materials usually have the undesirable effect of reducing the ability of the silicate to subsequently expand, thereby

resulting in a high density product with poor insulating properties.

STATEMENT OF THE INVENTION

Therefore, it is an object of the present invention to provide a route to an expanded insoluble aggregate based on alkali metal siilcates, said aggregate having excellent insulating properties.

It is a further object of the present invention to provide a process for the preparation of an expanded insoluble aggregate based on alkali metal silicates wherein the viscosity of the silicate-containing composition is increased without detriment to the silicate's ability to undergo thermal expansion.

A further object of the invention is to provide a process for the production of a silicate-based aggregate wherein the granulated silicate, prior to expansion, may be retained in particulate form for extended periods of time without caking.

These and further objects of the present invention will become apparent to those skilled in the art from the specification and claims which follow.

There has now been found a process for preparing an expanded insoluble aggregate based on alkali metal silicate, which process comprises:

(A) Mixing, at a temperature less than boiling, an aqueous alkali metal silicate having an alkali metal oxide:silicon dioxide weight ratio of from about 1:3.0–7.0 with an essentially anhydrous alkali metal silicate within the same weight ratio range, the amount of anhydrous added being that quantity sufficient to give, in combination with the aqueous, a total alkali metal silicate solids content of from 80–40 percent by weight and the amount of alkali metal silicate solids being 40–90 percent by weight, dry basis, of the total resultant aggregate;

(B) Admixing, prior to the time when the anhydrous alkali metal silicate becomes substantially hydrated, two insolublizing compounds as follow;

(1) a primary insolubilizer capable of reacting with the alkali portion of the alkali metal silicate at temperatures less than boiling, the amount used being that sufficient to reduce hygroscopicity of the silicate to the point where caking of the composition prior to expansion but subsequent to grinding is prevented and

(2) a secondary insolubilizer capable of reacting with the silicate portion of the alkali metal silicate at temperatures used in expanding same, the amount used being that sufficient to render the expanded aggregate water-insoluble,

the total amount of insolubilizers used being less than the stoichiometric amount required for total reaction with the alkali metal silicate present;

(C) Continuing mixing until the components will not separate on standing at temperatures up to boiling;

(D) Curing the mixed composition at temperatures up to boiling until the anhydrous alkali metal silicate has become substantially hydrated and the primary insolubilizer reacted;

(E) Cooling the composition to a grindable solid;

(F) Grinding the composition into discrete nonadherent particles suitable for expansion and

(G) Rapidly expanding the particles and causing the secondary insolubilizer to react by exposure to temperatures of from about 800°–1800° F.

The use of anhydrous silicate to increase the total silicate solids content of the mixture to within the stated range has the advantage of converting the silicate to a grindable form, without decreasing its ability to undergo subsequent expansion, while maintaining the amount of water present, which water must ultimately be removed, at