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PRODUCTION OF POROUS BUILDING MATERIALS

Hans Wolf and Hermann Leuchs, Ludwigshafen-on-the-Rhine, and Hans Saenger, Bitterfeld, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt-on-the-Main, Germany

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This application is a continuation-in-part to Ser. No. 360,616, filed May 4th, 1929.

The present invention relates to the production of porous building materials.

5 It has already been proposed to make cement-like materials of cellular structure by preparing a mixture of hydraulic cement, water and a frothing flotation reagent and, if desired, an inert filler, the pulp obtained being then agitated to form a froth. The said frothing flotation reagents comprise pine oil mixtures with heavy oils such as petroleum or coal tar, phosphoresylic acid, oleic acid or other oily organic acids. Although the customary process of pouring concrete in the building industry furnishes building materials of high tensile and compression strength, it is attended with drawbacks which are considerable when the building materials to be produced are not required to be specially strong. In these cases, the concrete building material forms a useless ballast, owing to its heavy weight, entails the consumption of unnecessary quantities of expensive material, and furnishes walls which are defective as regards the insulation of heat and sound.

25 We have now found that building materials which are porous and free from the said drawbacks can be produced in a highly advantageous manner, by making the hydraulic mineral binding media into a frothy pulp together with water and a certain amount of water-glass with the aid of true sulphonic acids of organic compounds containing at least six carbon atoms in their molecule, the said pulp being then cast into moulds in the usual manner. The true sulphonic acid substances employed can be chosen from the great number of products of this kind which are well known and employed as wetting out agents especially for use in the textile industry. The said true sulphonic acids comprise sulphonic acids of long chain fatty acids, i. e. containing at least 6, preferably at least 10 carbon atoms, which acids may be unsaturated and/or hydroxylated, such as for example stearic, oleic, myristic, lauric, palmitic, or ricinoleic acids, sulphonic acids of mineral or tar oils, or of fractions thereof, sulphonic acids of aromatic hydrocarbons, such as benzene or naphthalene, and more particularly sulphonic acids of alkylated aromatic hydrocarbons, such as toluene, xylene, mono-ethyl benzene, di-ethyl benzene, methyl-ethyl benzene, or mono-, di-, and tri-methyl-, -ethyl-, -propyl-, -iso-propyl-, -butyl-, -iso-butyl naphthalene. The said true sulphonic acids also comprise those obtainable by condensing taurine ($\text{NH}_2\text{—CH}_2\text{—CH}_2\text{—SO}_3\text{H}$) or its N-mono-alkylated derivatives with one of the aforesaid long chain fatty acids or with mixtures of such acids; processes for the preparation of such condensation products are described for example in the

British specifications No. 341,053, and No. 343,899; similarly, condensation products obtainable from hydroxyethane sulphonic acid and long chain fatty acids, for example according to the British specification No. 366,916, may likewise be employed.

Instead of employing the said true sulphonic acids in the free state, any salts thereof may be employed, which salts are equivalents for the purposes of the present invention. The said salts may be chosen from those with organic, nitrogenous bases such as pyridine, aniline, mono-, di- or tri-ethyl amine, or mono-, di-, or tri-ethanol amine, but we prefer to employ salts with inorganic bases such as ammonia, and especially those with metals such as the alkali metals, i. e. sodium, potassium, lithium, caesium or rubidium, the alkaline earth metals, such as barium, calcium and strontium, including magnesium, aluminium and beryllium.

30 The aforesaid true sulphonic acids and their salts will be referred to for the sake of brevity in the following as foam producing sulphonic acid substances. It must be pointed out that products of the aforesaid nature of organic compounds which contain less than six carbon atoms are not foam producing agents within the meaning of the above definition. Similarly, sulphuric esters of organic compounds, i. e. substances which are differentiated from the true sulphonic acids by the fact that the sulphur atom of the sulphuric group is connected by an oxygen atom to a carbon atom of the organic compound ($\text{R—O—SO}_3\text{H}$ =sulphuric ester, $\text{R—SO}_3\text{H}$ =true sulphonic acid, R =organic radical), do not come into consideration for the purpose of the present invention, because they do not allow of the production of porous building materials having the properties required in practice.

40 The water-glass is incorporated with the said hydraulic mineral binding media when all the other additions have been added.

The quantity employed of the said foam producing sulphonic acid substances can be varied depending on the desired degree of porosity. Generally from about one-tenth of one per cent to about one per cent, by weight of the hydraulic binding agent, will be sufficient. Larger amounts, such as 2, 3 or 5 per cent, by weight of the said hydraulic binding agents, may, however, also be employed. The amount of waterglass, i. e. sodium or potassium silicate, is usually from about 1 to about 4, preferably about 2.5, per cent by weight of the said hydraulic binding agent; since about 55 per cent by weight of water is contained in the commercial water-glass, the commercial water-glass of 38° Bé. is generally employed in an amount of from about 2.5 to about 10, preferably from about 6 to about 7.5 per cent, by weight of the said hydraulic binding agents. The

amount of water employed is usually between about 12 and about 17, up to about 60, per cent by weight of the said hydraulic binding agent. The masses prepared in this manner are easily poured, stand well in the shapes or moulds and exhibit, when set, a perfectly homogeneous microporous structure of low specific gravity. Moreover, the mechanical strength of the building materials is comparatively high, porous building material showing an uncommonly high resistance to pressure being obtained according to the present invention.

The production of porous building materials may be effected in various ways. For example, the special kind of cement chosen, such as Portland cement, iron Portland cement, or blast furnace cement, or mixtures thereof, or other hydraulic mineral binding media such as gypsum or mixtures of such other hydraulic mineral binding media with cement, or a mixture of the cement or binding medium or mixture of cement and binding medium with between about 10 to 800 per cent, usually between about 100 and about 500 per cent, by weight of said binding medium, of suitable additions such as for example three times the weight of the amount of said cement, of sand, gravel, pumice or the like may be mixed with the said sulphonic acid substances, for example with the sodium salt of butylated or isopropylated naphthalenesulphonic acid, together with water, and after adding water-glass, the mixture worked into a uniform froth by means of the customary mixing machines, concrete mixers, or of stirrers, the introduction of gases, or in any other known and suitable way. The froth forming true sulphonic acid substances may, however, be added in the dry state to the hydraulic mineral binding medium, or to the mixture of the same and the additions, prior to adding the mixing liquid; or it may be dissolved in the mixing liquid and then incorporated with the other components. The foam can be cast into moulds for the preparation of articles of any form and size, or parts of buildings can be cast directly into the desired position on a building. A considerable acceleration of setting can be obtained by the employment of hot water.

acid substance, the kind or intensity of the stirring, the amount of the mixing liquid and the kind and quantity of the additions. The building materials can be cut, nailed and sawn.

The following examples will further illustrate the nature of the said invention which, however, is not restricted thereto. The parts are by weight.

Example 1

300 parts of dry sand, the single grains of which have an average diameter between about 0.1 and about 7 millimetres, 75 per cent of said grains having a diameter below 1 millimetre, are mixed with 60 parts of water containing 1 part of the sodium salt of isopropylated naphthalenesulphonic acid, the mixture being then incorporated with 100 parts of Portland cement. 5 parts of commercial sodium water-glass (containing about 55 per cent of water) are then allowed to flow into the mixture in a thin jet while stirring, and the whole is then stirred for about 3 minutes in a concrete mixer to a frothy pulp, which can be poured directly into moulds, shapes or the like, and sets to a microporous mass, having an apparent specific weight of about 1.3.

If the mixing operation in the concrete mixer is carried out for a longer time than 3 minutes, for example during 4, 5 or 6 minutes, products are obtained which show a still lower apparent specific weight.

The aforesaid sodium salt may be replaced by that of a mono- or di-butyl naphthalene sulphonic acid.

Example 2

In order to show the excellent results obtainable according to the process of the present invention by the employment, for the preparation of porous building materials, of true sulphonic acids as the foam forming agent, as compared with acid sulphuric esters, a series of different porous building materials have been prepared, the following table showing the specific conditions and ingredients employed in each case, and also the properties of the resulting porous building material.

	Water	Foam forming agent	Sand, diameter of grains 0.1 to 7 mm.	Portland cement	Water-glass 38° B _é . (sodium water-glass if not otherwise stated)	Stirring for . . . minutes	Resistance to pressure (kg. per cm. ²)	Apparent specific weight	
1	90 ccm.	0.9 g. n-butylated naphthalenesulphonic acid sodium salt.	450 grams.	150 grams.	7.5 ccm.	4	25.8	1.20	
2	75 do.	0.9 g. do.	450 do.	150 do.	7.5 do.	4	42.0	1.50	
3	85 do.	0.9 g. do.	450 do.	150 do.	7.5 do.	4	25.6	1.20	
4	14 liters.	120 g. do.	60 kg.	20 kg.	1 liter.	3	20.2	1.10	
5	85 ccm.	0.9 g. do.	450 grams.	150 grams.	7.5 ccm. (potassium).	4	23.9	1.35	
6	6 liters.	125 grams sodium salt of acid sulphuric ester of lauric alcohol.	38 kg.	12.5 kg.	600 ccm.	3			
7	6 do.	62.5 g. do.	38 do.	12.5 do.	600 do.	3			
8	6.6 do.	56.3 g. oleic acid ester of hydroxy ethane sulphonic acid sodium salt.	38 do.	12.5 do.	600 do.	3	18.2	1.48	
9	6.6 do.	41.3 g. oleic N-methyl tauride sodium salt.	38 do.	12.5 do.	600 do.	3	18.0	1.23	

The masses prepared according to this process can be adapted within wide limits, in respect of specific gravity and porosity, to the purposes in view, for example as building material or insulating material or for other purposes according to the amount of the froth forming sulphonic

In tests 4, 6, 7, 8 and 9 stirring has been carried out in a concrete mixer, whereas stirring has been done by hand in tests 1, 2, 3 and 5. The froth of tests 6 and 7 did not set to a building material of any practical value.

The above table shows the superiority of the

porous building materials prepared with the aid of true sulphonic acid substances in the presence of water-glass. It also shows that the process allows of the preparation of porous building material of any desired apparent weight, which material has a comparatively very great mechanical strength.

What we claim is:—

1. The process for the production of porous building materials which comprises making a hydraulic mineral binding medium into a frothy pulp together with water, waterglass and a true sulphonic acid substance of an aromatic compound containing at least 6 carbon atoms.

2. The process for the production of porous building materials which comprises making a hydraulic mineral binding medium into a frothy pulp together with water, waterglass and a true sulphonic acid substance of an alkylated aromatic compound containing at least 6 carbon atoms.

3. The process for the production of porous building materials which comprises making a hydraulic mineral binding medium into a frothy pulp together with water, waterglass and a true sulphonic acid substance of an alkylated naphthalene.

4. The process for the production of porous building materials which comprises making a hydraulic mineral binding medium into a frothy pulp together with water, waterglass and between about one-tenth per cent and about 5 per cent by weight of said hydraulic mineral binding medium, of a true sulphonic acid substance of an aromatic compound containing at least 6 carbon atoms.

5. The process for the production of porous building materials which comprises making a hydraulic mineral binding medium into a frothy pulp together with water, between about 1 and about 4 per cent, by weight of said hydraulic mineral binding medium, of waterglass, and between about one-tenth per cent and about 5 per cent, by weight of said hydraulic mineral binding medium, of a true sulphonic acid substance of an aromatic compound containing at least 6 carbon atoms.

6. The process for the production of porous building materials which comprises making a hydraulic mineral binding medium into a frothy pulp together with between about 12 and about 60 per cent, by weight of said hydraulic mineral binding medium, of water, between about 1 and about 4 per cent by weight of said hydraulic mineral binding medium, of waterglass, and between about one-tenth per cent and about 5 per cent, by weight of said hydraulic mineral binding medium, of a true sulphonic acid substance of an aromatic compound containing at least 6 carbon atoms.

7. The process for the production of porous building materials which comprises mixing a hydraulic mineral binding medium with between about 12 and about 60 per cent, by weight of said hydraulic mineral binding medium, of water, between about 10 and about 800 per cent, by weight of said hydraulic mineral binding medium, of sand, and between about one-tenth per cent and about 5 per cent, by weight of said hydraulic mineral binding medium, of a true sulphonic acid substance of an aromatic compound containing at least 6 carbon atoms, then adding between about 1 and about 4 per cent, by weight of said hydraulic

mineral binding medium, of waterglass, and making the whole mixture into a frothy pulp.

8. As new articles of manufacture, porous building materials comprising a set mixture of a hydraulic mineral binding medium, waterglass and a true sulphonic acid substance of an organic compound containing at least 6 carbon atoms.

9. As new articles of manufacture, porous building materials, comprising a set mixture of a hydraulic mineral binding medium, waterglass and between about one-tenth per cent and about 5 per cent, by weight of said hydraulic mineral binding medium, of a true sulphonic acid substance of an organic compound containing at least 6 carbon atoms.

10. As new articles of manufacture, porous building materials, comprising a set mixture of a hydraulic mineral binding medium, waterglass and between about one-tenth per cent and about 5 per cent, by weight of said hydraulic mineral binding medium, of a true sulphonic acid substance of an aromatic compound containing at least 6 carbon atoms.

11. As new articles of manufacture, porous building materials, comprising a set mixture of a hydraulic mineral binding medium, waterglass and between about one-tenth per cent and about 5 per cent, by weight of said hydraulic mineral binding medium, of a true sulphonic acid substance of an alkylated aromatic compound containing at least 6 carbon atoms.

12. As new articles of manufacture, porous building materials, comprising a set mixture of a hydraulic mineral binding medium, between about 1 and about 4 per cent, by weight of said hydraulic mineral binding medium, of waterglass and between about one-tenth per cent and about 5 per cent, by weight of said hydraulic mineral binding medium, of a true sulphonic acid substance of an alkylated aromatic compound containing at least 6 carbon atoms.

13. As new articles of manufacture, porous building materials comprising a set mixture of a hydraulic mineral binding medium, between about 1 and about 4 per cent, by weight of said hydraulic mineral binding medium, of waterglass and between about one-tenth per cent and about 5 per cent, by weight of said hydraulic mineral binding medium, of a true sulphonic acid substance of an alkylated naphthalene.

14. As new articles of manufacture, porous building materials, comprising a set mixture of a hydraulic mineral binding medium, about 300 per cent, by weight of said hydraulic mineral binding medium, of sand, between about 1 and about 4 per cent, by weight of said hydraulic mineral binding medium, of waterglass, and between about one-tenth per cent and about 5 per cent, by weight of said hydraulic mineral binding medium, of a true sulphonic acid substance of an alkylated naphthalene.

15. As new articles of manufacture, porous building materials, comprising a set mixture of cement, about 300 per cent, by weight of said cement, of sand, between about 1 and about 4 per cent, by weight of said cement, of waterglass, and between about one-tenth per cent and about 5 per cent, by weight of said cement, of a true sulphonic acid substance of an alkylated naphthalene.

HANS WOLF.
HERMANN LEUCHS.
HANS SAENGER.