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(54) **Rendszer és eljárás helyszínen történő hab előállítására**

Method and system for creating an in-situ foam

Description

The present invention relates to a system and a process for producing an in-situ foam and also its use.

In-situ foams based on urethanes, curable aminoplastic condensates or phenolic resins have been known for a long time. A disadvantage is that they are flammable and shrink on drying. DE 25 42 471 describes a process for producing low-shrinkage foams from curable aminoplastic condensates in the presence of shrinkage- and flammability-reducing reaction products of orthoboric acid and polyhydric alcohols or polyalkylene glycol ethers of polyhydric alcohols.

WO 2011/051170 describes a process for producing an elastic inorganic-organic hybrid foam having good heat and sound absorption properties. The foam is obtained by foaming a mixture of gypsum or kaolin, an aqueous polyvinylamine solution, a volatile organic compound as blowing agent, an emulsifier and crosslinker. Owing to the blowing agents used, flush filling of hollow spaces with foam is not possible.

WO 2009/109537 describes a process for producing a foam having a high flame resistance and low density by curing a mechanical or blown foam composed of an aqueous composition comprising alkali metal silicates, surfactants and an aqueous polymer dispersion. Film formation by drying of the polymer dispersion is too slow for use as in-situ foam.

JP-A 11-27931 describes a flame-resistant spray foam based on polyurethanes which is obtained by mixing an aqueous phosphoric acid solution and optionally inorganic fillers with a mixture of urethane prepolymers comprising NCO groups and calcium carbonate under superatmospheric pressure.

DE 199 12 988 C1 discloses filler-comprising foams based on polyurethanes and their suitability as thermal insulation and insulating materials and also as fire retardant foams.

WO 2008/007187 describes a hybrid foam based on polyurethanes and inorganic fillers having good thermal and acoustic insulation properties, permeability and flame protection and also good adhesion to concrete.

If in-situ foams based on polyurethanes are used for filling virtually closed hollow spaces, the formation of CO_2 in the reaction of the components can lead to a high pressure buildup in the hollow spaces, so that the walls burst.

It was an object of the present invention to remedy the abovementioned disadvantages and provide a system and a process for producing an in-situ foam which displays low shrinkage and low emissions and is sufficiently solid to be cut within a short time. Furthermore, it should also allow flush filling of even irregular and/or virtually closed hollow spaces with foam and, for fire protection, have a low heat of combustion, preferably less than 3.0 MJ/kg, very low smoke formation and no dripping of burning material.

The object is achieved by a system for producing an in-situ foam, which comprises the components

from 50 to 98% by weight, preferably from 85 to 95% by weight, of one or more inorganic fillers A),

from 1 to 48% by weight, preferably from 2 to 10% by weight, of one or more water-soluble, cationic polymers B),

from 0.5 to 48% by weight, preferably from 1 to 10% by weight, of one or more surfactants C),

from 0.01 to 5% by weight, preferably from 0.1 to 1% by weight, of one or more crosslinkers D) which are capable of reacting with the polymers B),

from 0 to 20% by weight, preferably from 1 to 10% by weight, of one or more additives E),

where the percentages by weight of the components A) to E) are based on solids or the nonaqueous fraction and the sum of A) to E) is 100% by weight.

Component A)

As component A), the system comprises one or more inorganic fillers, in particular minerals, for example colloidal silica, silicates such as aluminum silicates, in particular kaolin $Al_2O_3 * 2SiO_3 * 2 H_2O$ or kaolinite $Al_4[(OH)_8Si_4O_{10}]$, sulfates such as calcium sulfate, in particular water-containing sulfates $Ca[SO_4] * n H_2O$ where n = 1/2, 2 (gypsum), or mixtures thereof. Particular preference is given to using calcium sulfate, FGD gypsum from flue gas desulfurization plants, aluminum silicates, in particular kaolin, or mixtures thereof.

The component A is preferably used as naturally occurring mineral and has preferably not been surface-treated. The average particle diameter of the component A) is preferably in the range from 0.1 to 10 µm. The density of the component A) is preferably in the range from 2 to 3 kg/m^3.

Component B)

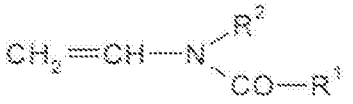
As component B), the system comprises one or more cationic polymers. Preference is given to ones which bear primary or secondary amino groups. The polymer B) is water-soluble, i.e. the solubility in water is at least 5% by weight, preferably at least 10% by weight, under standard conditions (20°C, 101.3 kPa) at pH 7. It is used in the form of an aqueous solution, preferably in a concentration of at least 50 g/l, in particular at least 100 g/l.

Examples of cationic polymers B are polymers obtained by polymerization of one or more monomers selected from among vinylamine, allylamine, ethylenimine, vinylimidazole, N-alkylaminoethyl acrylate, N-alkylaminoethyl methacrylate, N-alkylaminopropylacrylamide, N-alkylaminopropylacrylamide, N,N-dialkylaminoethyl acrylate, N,N-dialkylaminoethyl methacrylate, N,N-dialkylaminopropylacrylamide, N,N-dialkylaminopropylacrylamide.

It is likewise possible to use polymers which bear primary or secondary amino groups and are based on renewable raw materials such as saccharides, e.g. chitosan.

The polymers comprising vinylamide units described in WO 2010/145956 or the copolymers which can be obtained by subsequent partial or complete removal of formyl groups from the N-vinylformamide copolymerized in the polymer to form amino groups.

Preference is given to polymers which are obtained by complete or partial hydrolysis of polymers which can be obtained by polymerization of at least one monomer of the formula



(I),

where R^1, R^2 = H or C_1-C_6-alkyl. Preferred monomers of the formula (I) are N-vinylformamide, N-vinyl-N-methylformamide, N-vinylacetamide, N-vinyl-N-methylacetamide, N-vinyl-N-ethylacetamide, N-vinyl-N-methylpropionamide and N-vinylpropionamide.

Particular preference is given to polyvinylamine or poly(vinylamine-vinylformamide) copolymers.

The charge densities of the cationic polymers B (without counterions) are generally in the range from 1 to 23 meq/g, preferably in the range from 3 to 14 meq/g, particularly

preferably in the range from 4 to 11 meq/g. The weight average molecular weights are usually in the range from 50 000 to 2 000 000, preferably in the range from 100 000 to 1 000 000, particularly preferably in the range from 300 000 to 500 000. Particular preference is given to polyvinylamines and copolymers thereof which are marketed under the trade name Lupamin®. Examples are Lupamin®9030, Lupamin®9050, Lupamin®9095.

Component C)

As component C), the system comprises one or more surfactants which are used for forming and stabilizing the foam. It is possible to use anionic, cationic, nonionic or amphoteric surfactants as surfactants.

Suitable anionic surfactants are diphenylene oxide sulfonates, alkanesfulonates and alkylbenzenesulfonates, alkylnaphthalenesulfonates, olefin sulfonates, alkyl ether sulfonates, alkylsulfates, alkyl ether sulfates, alpha–sulfofatty acid esters, acylaminoalkanesulfonates, acylisethionates, alkyl ether carboxylates, N–acylsarcosinates, alkylphosphates and alkyl ether phosphates. Nonionic surfactants which can be used are alkylphenol polyglycol ethers, fatty alcohol polyglycol ethers, fatty acid polyglycol ethers, fatty acid alkanolamides, EO/PO block copolymers, amine oxides, glyceryl esters of fatty acids, sorbitan esters and alkyl polyglucosides. Cationic surfactants used are alkyltriammonium salts, alkylbenzyldimethylammonium salts and alkylpyridinium salts.

Particular preference is given to using mixtures of anionic and nonionic surfactants.

Component D)

As component D), the system comprises one or more crosslinkers D) which can react with the component B). Preference is given to using aldehydes, isocyanates, epoxides,

acrylates, acrylamides, esters, divinylsulfonates, particularly preferably ethanedial, as crosslinkers D).

Component E)

As component E), the system can comprise one or more additives. Possible additives are, in particular, compounds which reduce the shrinkage or the water absorption of the in-situ foam. To reduce the shrinkage, it is possible to use, for example, dimethyldihydrophyethylurea. The water absorption can, for example, be reduced by means of self-crosslinking styrene-acrylate dispersions.

To improve the foamability, it is possible to add viscosity-increasing additives, e.g. starch, modified celluloses or polyvinyl alcohol.

The system does not comprise any volatile organic blowing agents such as low-boiling C_4-C_8-hydrocarbons, alcohol, ethers, ketones and esters.

To achieve good fire protection, the proportion of organic constituents in the in-situ foam should be very low. Preference is given to using a system in which the proportion of organic constituents is so low that the in-situ foams pass the burning test A2 in accordance with DIN 4102 and have a fire resistance F30 at a thickness of 50 mm and F60 at a thickness of 100 mm. The sum of the solids (nonaqueous fractions) of the components B), C), D) and E) is therefore preferably in the range from 2 to 15% by weight, particularly preferably in the range from 5 to 11% by weight, based on the in-situ foam.

The invention also provides a process for producing an in-situ foam using the above-described components A) to E) of the system and foaming by means of a gas or a gas mixture.

The in-situ foam can be obtained by mixing and foaming an aqueous composition composed of the components A) to E) with a gas or a gas mixture under superatmospheric pressure and action of mechanical forces such as stirring or shearing by means of static mixers. It is also possible to foam the aqueous composition by dispersing an inert gas in the form of fine gas bubbles in it. The introduction of gas bubbles into the aqueous composition can be effected by means of beating, shaking, stirring, whip-stator or rotor apparatuses. Preference is given to using mixtures having stator and/or rotor elements.

As gas or gas mixture, preference is given to using inert gases such as nitrogen, argon, carbon dioxide or oxygen. Particular preference is given to using air.

In order to produce the in-situ foam, an aqueous suspension with a solids content in the range from 30 to 50% by weight is preferably prepared from the components A) to D) and foamed by introducing compressed air having a pressure in the range from 100 to 2000 kPa.

The process preferably comprises the steps

(a) introduction of a gas or a gas mixture into an aqueous solution or suspension comprising at least the components C),
(b) optionally mixing-in of further components A) to E) either together or separately by means of one or more mixing elements,
(c) foaming of the aqueous suspension comprising at least the components A) to C),
(d) optionally addition of the component D),
(e) drying to a water content below 0.5% by weight.

In step (a), preference is given to introducing compressed air having a pressure in the range from 100 to 2000 kPa.

The mixing-in of the components A) to E) can be carried out either together or separately by means of one or more mixing elements. The components B) and D) of the system or the premixes comprising these components are preferably stored separately and mixed only on site to produce the in-situ foam. The introduction is preferably carried out via different points of introduction on the apparatus.

The in-situ foam can be produced in commercial foaming apparatuses for in-situ foams. Suitable apparatuses for producing the in-situ foam (F) are shown schematically in figures 1-3.

The apparatus as shown in fig. 1 comprises three static mixers (SM 1, SM 2 and SM 3) having three metering devices (D1, D2 and D3). The components C) and the gas or the gas mixture are preferably introduced via the metering device (D1), the components A), B) and E) are preferably introduced together via the metering device (D2) and the component D) is preferably introduced via the metering device (D3).

The apparatus as shown in fig. 2 comprises only one static mixer (SM 1) with the metering device (D1) for introduction of the aqueous composition composed of components A) to E).

The apparatus as shown in fig. 3 corresponds to the apparatus shown in fig. 2 with an additional metering device (D2). Here, the components A), B), C) and optionally E) can be introduced together via the metering device D1 and the component D) can be introduced separately therefrom via the metering device D2.

In general, the components B) – D) are used in the form of aqueous solutions. To adapt the viscosity, further water can be added to individual components or mixtures of components. The aqueous suspension in step (c) preferably has a solids content in the range from 5 to 50% by weight, particularly preferably from 10 to 30% by weight.

The invention also provides an in-situ foam which can be obtained by the process of the invention. The density can be set within a wide range as a function of the foaming

apparatus used, the number of mixing elements and the setting of the pressure. The in-situ foam preferably has a density in the range from 10 to 300 kg/m^3.

In general, the in-situ foam which can be obtained by the process of the invention has a lower average pore diameter and a narrower pore size distribution compared to a blown foam having the same composition and blown by means of blowing agents. The more homogeneous foam structure of the in-situ foam is also reflected in a lower thermal conductivity. The in-situ foam of the invention preferably has an average pore diameter below 1 mm. The distribution of the pore diameters is preferably in the range 0.2-1 mm. In comparison, the average pore diameter in the blown foam is in the range 1-5 mm and the distribution of the pore diameters is in the range 1-4 mm.

The in-situ foam preferably has a combustion energy, determined in accordance with DIN 51900 part 3, of less than 3.0 MJ/kg, preferably in the range from 0.1 to 2.9 MJ/kg.

The water absorption after storage of the foam specimens in a controlled temperature and humidity chamber at 85% humidity to constant weight is preferably from 1 to 35% by weight, particularly preferably from 5 to 20% by weight.

The shrinkage after storage of the foam specimens in a controlled temperature and humidity chamber at 85% humidity to constant weight is preferably from 0.1 to 10%, particularly preferably from 1 to 7%.

The in-situ foam is preferably firm in air at 20°C within a period in the range from 5 to 50 seconds, particularly preferably in the range from 10 to 25 seconds, after foaming. The in-situ foam is suitable for thermal insulation and for filling hollow spaces and hollow bodies, in particular for insulating hollow spaces in building constructions, for example by filling double masonry walls. Furthermore, the in-situ foam is suitable for the interior insulation of building constructions, in particular walls, ceilings, ceilings having a crawl space and roofs, for filling hollow blocks with foam to improve the insulation performance, for insulating pipes and engineering components, for the fire-

resistant closure of openings through masonry walls for, for example, lead-throughs for lines and also for filling fire doors, doors and window profiles. The in-situ foam is also suitable as fire barrier or part of a fire barrier in buildings or for filling hollow spaces and hollow bodies.

The in-situ foam can be used either alone or in combination with one or more other insulation materials in the form of boards or flocs for these and other applications. Suitable insulation materials are foamed polymers such as expanded foams composed of white or gray, expandable polystyrene (EPS, Styropor®, Neopor®) or extruded styrene foams (XPS, Styrodur®) or polyurethane foams (PUR), foamed elastomers based on neoprene rubber or EPDM, inorganic insulation materials such as mineral fibers, rockwool, glass wool, granulated glass foam, foamed glass, expanded perlite or silicate foams, natural insulation materials such as sheep's wool, flax, soft wood fiber boards, lightweight wood wool construction panels, cork, coconut fiber mats or cellulose. The in-situ foam according to the invention can preferably be used together with mineral wool.

Examples

Starting materials:

Component A1	FGD gypsum (from a flue gas desulfurization plant), $CaSO_4.2H_2O$, calcium sulfate dihydrate
Component A2.1	kaolin (from Fluka, uncalcined aluminum silicate, $Al_2Si_2O_5(OH)_4$, pharmaceutical grade)
Component A2.2	Ansilex® 93 (calcined kaolin, not surface-treated, average particle size 0.9 µm)
Component B1.1	Lupamin® 9050 (copolymer of vinylformamide and vinylamine (1:1) having a high molecular weight; 10% strength solution in water, pH about 8, with chloride as counterion)

Component B1.2	Lupamin® 9070 (copolymer of vinylformamide and vinylamine (3:7) having a high molecular weight; 10% strength solution in water, pH about 8, with chloride as counterion)
Component B1.3	Lupamin® 9050 (copolymer of vinylformamide and vinylamine (1:1) having a high molecular weight; 10% strength solution in water, pH about 8, with benzoic+amidosulfonic acid (1:1) as counterion)
Component C1	surfactant mixture of anionic and nonionic surfactant: Disponil FES 32 (sodium lauryl polyether sulfate) and Lutensol AT80 (fatty acid ethoxylate) in a weight ratio of 1:3;
Component C2	AmphosolCS-50 (cocamidopropyl hydroxysultaine)
Component D1	Glyoxal (ethanedial, oxalaldehyde)
Component D2	Waterpoxy® 1422 (epoxy resin dispersion in water, 53-57%, 2-6 Pa.s)
Component E1	Durapox® NT (two-component reactive resin system with epoxide as resin component and a mixture of isophoronediamine and N-(3-aminopropyl)-N-dodecylpropane-1,3-diamine as hardener component)
Component E2	Acronal® 5044 (aqueous self-croselinkable dispersion of a copolymer of an acrylic ester and styrene, solids content 55% by weight, film formation temperature Tg ~15°C, particle size ~400 nm, pH 6.5-8.5, viscosity 10-100 mPas
Component E3	Fixapret® NF: dimethyldihydroxyethylurea
Component E4	melamine (pure, powder)

Examples 1-10

For examples 1-10, an aqueous solution of the component C was foamed by means of compressed air (2000 kPa) in the first mixing element SM 1 of a set-up as per fig. 1 having three static mixing elements (SM 1, SM 2, SM 3) having diameters in the range from 5 to 10 mm. A mixture of the components A1, A2, B and E and optionally

additional water to set the solids content of the suspension was subsequently added via the second mixing element SM 2. Finally, the component D was introduced in the third mixing element SM 3 and homogeneously mixed in. The foam is conveyed through the further mixing elements to the exit nozzle by the introduction of compressed air into the set-up before the first mixing element. Drying was carried out at 20°C in air.

Examples 11-16

In examples 11 and 16, the components A) to D) and optionally additional water for setting the solids content of the suspension were foamed together by means of compressed air in an apparatus as per fig. 2 having a static mixing element (SM 1) having a diameter of 25 mm at an operating pressure of 500 kPa. Drying was carried out at 20°C in air.

Tables 1 and 2 show the components A to E for producing the in-situ foams in percent by weight, in each case based on the nonaqueous fraction, and the properties of the dried in-situ foam. The solids content (nonaqueous fraction) in percent by weight is based on the mixture of the components before foaming (examples 11 and 16).

The density of the foam specimen was determined by weighing and measurement of length, width and height. The heat of combustion was determined in accordance with DIN 51900 part 3. To determine the water absorption (% by weight), the foam specimens were stored in a controlled temperature and humidity chamber at 85% humidity until the weight was constant. The cutting solidity after foaming was determined by means of a knife and a chronometer. A specimen is considered to be cutting-solid when a piece of the specimen can be cut off by means of the knife and lifted away without this piece losing its shape. To determine the shrinkage, the foam specimens were stored in a control temperature and humidity chamber at 85% humidity until the weight was constant and the dimensional changes were measured.

Table 1 Starting materials for the in-situ foams of examples 1-10 in percent by weight, based on the nonaqueous fraction of the components, and properties of the dried in-situ foams

Component	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8	Ex. 9	Ex. 10
A1	55.7	32.6	58.7	58.7	62.2	58.7	58.9	60.1	59.6	59.8
A2.1	27.8	16.3	29.4	29.4	31		29.3	30.0	29.7	29.8
A2.2						29.4				
B1.1	8.3	4.9	8.8	8.8	5	8.8	4.7	7.5	3.1	9
B1.2										
B1.3										
C1	7.6	45.8	2.5	2.5	1.4	2.5	1.3	1.3	1.3	1.3
C2										
D1	0.6	0.3	0.6	0.6	0.2	0.6	0.1	0.2	0.2	0.01
D2										
E1								0.9		
E2									6.1	
E3					0.3					
E4							5.6			
Solids content of suspension [% by weight]	40	26	34	30	45	30	47	41	48	43
Properties of in-situ foam										
Density [kg/m^3]	240.9	40.2	172.3	95.2	50.7	95.6	94.2	97.1	95.2	95.2
Heat of combustion [MJ/kg]	> 3	> 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3
Water absorption [% by weight]	32	33	32	31	33	32	20	15	8	14
Cutting-solid [sec]	20	22	21	21	22	20	21	19	22	208
Shrinkage [%]	8	7	7	8	2	1	7	8	7	7
Thermal cond. λ [mW/m*K]					40					

Table 2 Starting materials for the in-situ foams of examples 11-16 in percent by weight, based on the nonaqueous fraction of the components, and properties of the dried in-situ foams

Component	Ex. 11	Ex. 12	Ex. 13	Ex. 14	Ex. 15	Ex. 16
A1	62.4	62.4	62.4	62.4	62.4	62.4
A2.1	31.1	31.1	31.1	31.1	31.1	31.1
A2.2						
B1.1	5	5			5	5
B1.2			5			
B1.3				5		
C1	1.4	1.4	1.4	1.4		1.4
C2					1.4	
D1	0.2	0.2	0.2	0.2	0.2	
D2						0.2
E1						
E2						
E3						
E4						
Solids content of suspension [% by weight]	45	32	32	32	32	32
Properties of in-situ foam						
Density [kg/m^3]	35.2	26.9	36.1	32.7	25.8	35.9
Heat of combustion [MJ/kg]	< 3	< 3	< 3	< 3	< 3	< 3
Water absorption [% by weight]	16	9	33	17	33	25
Cutting-solid [sec]	18	21	830	22	20	21
Shrinkage [%]	7	8	9	8	7	9
Thermal cond. λ [mW/m*K]		36				

Szabadalmi igénypontok

1. Rendszer helyszínen történő hab előállításra, amely az alábbi összetevőket foglalja magában

50 - 98 tömeg% egy vagy több szervetlen A) töltőanyagot,

1 - 48 tömeg% egy vagy több vízoldható, kationos B) polimert,

0,5 - 48 tömeg% egy vagy több C) felületaktív anyagot,

0,01 - 5 tömeg% egy vagy több B) polimerrel reagálni képes D) térhálósítót,

0 - 20 tömeg% egy vagy több E) adalékanyagot,

ahol az A) - E) összetevők tömegszázaléka a nem-vizes részre vonatkozik és A) - E) összege 100 tömeg% .

2. Az 1. igénypont szerinti rendszer, **azzal jellemezve, hogy** kationos polimerként polivinilamint vagy poli(vinilamin-vinilformamid) kopolimert tartalmaz.

3. Az 1. vagy 2. igénypont szerinti rendszer, **azzal jellemezve, hogy** C) felületaktív anyagként anionos és nem-ionos felületaktív anyagok keverékét tartalmazza.

4. Az 1-3. igénypontok bármelyike szerinti rendszer, **azzal jellemezve, hogy** D) térhálósítóként egy dialdehidet tartalmaz.

5. Az 1-4. igénypontok bármelyike szerinti rendszer, **azzal jellemezve, hogy** A) szervetlen töltőanyagként kálcium-szulfátot, alumínim-szilikátokat vagy ezek keverékét alkalmazzuk.

6. Eljárás helyszínen történő hab előállításra az 1-5. igénypontok bármelyike szerinti rendszer összetevőinek felhasználásával és egy gázzal vagy gáz keverékkel történő habosítással.

7. A 6. igénypont szerinti eljárás, **azzal jellemezve, hogy** az A)-D) összetevőkből 30 - 50 tömeg% szárazanyag tartalmú vizes szuszpenziót készítünk és 100 - 2000 kPa tartományba eső nyomású sűrített levegővel habosítjuk.

8. A 6. igénypont szerinti eljárás, amely az alábbi lépéseket foglalja magában:

(a) legalább a C) összetevőket tartalmazó vizes oldatba vagy szuszpenzióba egy gáz vagy gázkeverék bevezetése,

(b) adott esetben további A) - E) összetevők együttes vagy egyenkénti bekeverése egy vagy több keverő elemen keresztül,

(c) a legalább az A) - C) összetevőket tartalmazó vizes szuszpenzió habosítása,

(d) adott esetben a D) összetevő hozzáadása,

(e) szárítás 0,5 tömeg% víztartalom alá.

9. A 8. igénypont szerinti eljárás, **azzal jellemezve, hogy** az (a) lépésben 100 - 2000 kPa tartományba eső nyomású sűrített levegőt vezetünk be.

10. A 8. vagy 9. igénypont szerinti eljárás, **azzal jellemezve, hogy** a (c) lépésben a vizes szuszpenzió szárazanyag tartalma 30 - 50 tömeg% tartományba esik.

11. Levegőn 20°C-on a habosítástól számított 5 - 50 másodperccen belül vágható helyszínen előállított hab, amely a 6-10. igénypontok bármelyike szerinti eljárással előállítható.

12. A 11. igénypont szerinti helyszínen előállított hab, **azzal jellemezve, hogy** sűrűsége a 10 - 300 kg/m^3 tartományba esik.

13. A 11. vagy 12. igénypont szerinti helyszínen előállított hab, **azzal jellemezve, hogy** égéshője kisebb, mint 3,0 MJ/kg.

14. A 11-13. igénypontok bármelyike szerinti helyszínen előállított hab alkalmazása hőszigetelésre.

15. A 11-13. igénypontok bármelyike szerinti helyszínen előállított hab alkalmazása üregek és üreges testek kitöltésére.

16. A 11-13. igénypontok bármelyike szerinti helyszínen előállított hab alkalmazása tűzvédelmi berendezésben vagy tűzvédelmi berendezés részeként.

A meghatalmazott:

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Fig. 1

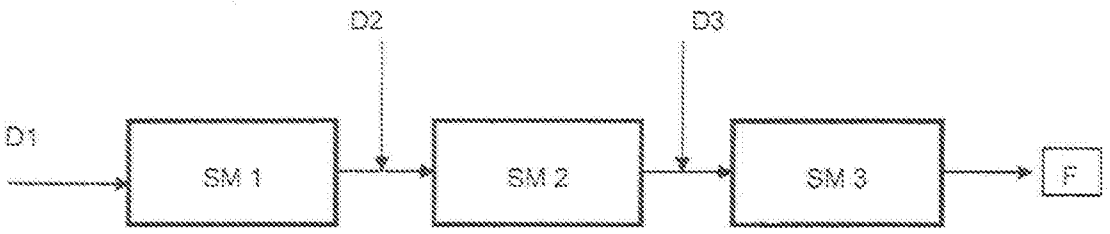

Fig. 2

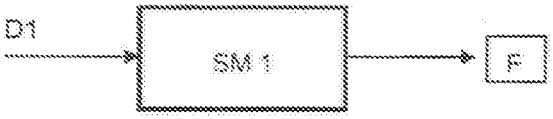

Fig. 3