PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : C03C 1/02, C03B 1/02

A1

(11) International Publication Number: WO 97/25285

(43) International Publication Date: 17 July 1997 (17.07.97)

(21) International Application Number: PCT/EP97/00023

(22) International Filing Date: 3 January 1997 (03.01.97)

(30) Priority Data:
196 00 299.0 5 January 1996 (05.01.96) DE

(71) Applicant (*for all designated States except US*): ISOVER SAINT-GOBAIN [FR/FR]; Les Miroirs, 18, avenue d'Alsace, F-92400 Courbevoie (FR).

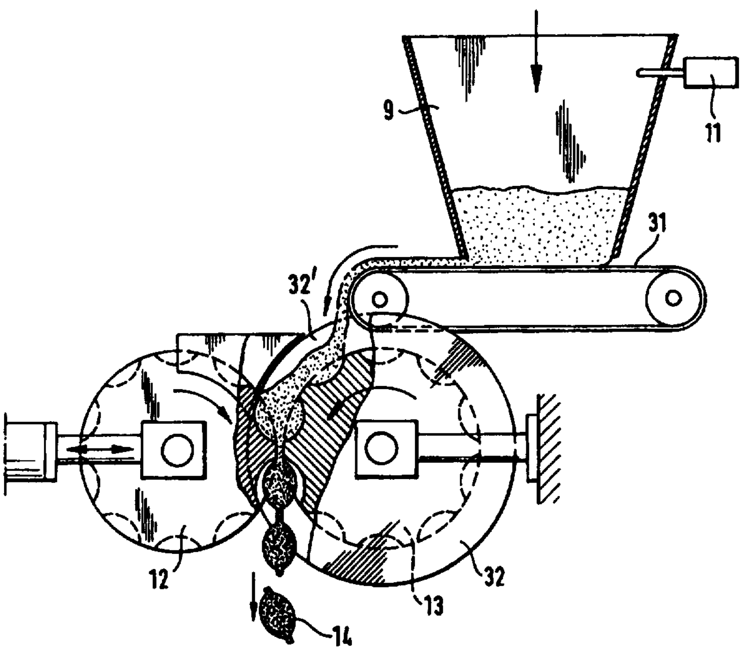
(72) Inventors; and
(75) Inventors/Applicants (*for US only*): MELLEM, Joachim [DE/DE]; Birkenallee 8/1, D-68766 Hockenheim (DE). HIRSCHMANN, Klemens [DE/DE]; Kanzelbachstrasse 29, D-68549 Ilvesheim (DE).

(74) Agent: KUHNEN, WACKER & PARTNER; Alois-Steinecker-Strasse 22, D-85354 Freising (DE).

(81) Designated States: AU, CA, CZ, DE, HU, NO, PL, SI, SK, TR, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: FORMED BODY, AND METHOD AND DEVICE FOR PRODUCING IT



(57) Abstract

A shaped body, e.g. a briquette, is obtained by compacting a mixture based on granular or powdery glass-forming raw materials, inorganic binding agent and water. Clinker cement is used as the organic binding agent and the raw material is compacted to an apparent density amounting to at least 90 % of the theoretical maximum material density of the dry mixture using a roll press briquetting apparatus. The process comprises adjusting the glass batch quantification to take account of the glass forming constituents of the cement.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgystan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic			SE	Sweden
CG	Congo	KR	Republic of Korea	SG	Singapore
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LR	Liberia	SZ	Swaziland
CS	Czechoslovakia	LT	Lithuania	TD	Chad
CZ	Czech Republic	LU	Luxembourg	TG	Togo
DE	Germany	LV	Latvia	TJ	Tajikistan
DK	Denmark	MC	Monaco	TT	Trinidad and Tobago
EE	Estonia	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	UG	Uganda
FI	Finland	ML	Mali	US	United States of America
FR	France	MN	Mongolia	UZ	Uzbekistan
GA	Gabon	MR	Mauritania	VN	Viet Nam

Description

Formed body, and method and device for producing it

The invention concerns a formed body obtainable by compacting a mixture based on granular or powdery glass-forming raw materials, clinker cement and water. The invention furthermore concerns a method and a device for producing formed bodies.

In the present context, the term "clinker cement" generally designates a material constituting a hydraulic binder which rapidly sets to reach service durability, at the most within several hours at the given high degree of compression, and the components of which substantially are substances also contained in the glass, as will in the following be explained in detail for the type of cement commercialised under the name of clinker cement.

The formed bodies are particularly suited for charging a glass melting tub.

The raw materials used for melting glass, such as quartz sand, lime, dolomite and soda are commonly supplied to the glass melting tub in a granular or powdery state. This manner of proceeding is, however, disadvantageous in that it includes the risk of the single raw material components segregating during storage, transport and feeding to the glass melting furnace owing to different densities, grain sizes and other varying physical properties. This has a negative influence on the quality and the product properties of the glass to be produced. Particularly in raw material mixtures this may lead to the impossibility of melting them.

Moreover in glass melting tubs ventilated by a gas flow, particularly raw material mixtures including a large proportion of fine-particle mixture components result in accumulation of dust in the exhaust conduit. Dust settles inside the exhaust conduit and results in clogging. If the dust is not compatible with the materials of the tub wall and its exhaust conduits, this may even result in destruction of the tub wall and of the exhaust conduits.

It has already been suggested to manufacture formed bodies from glass-forming raw materials which comprise a binding agent and apparent densities of the formed bodies of less than 70% of the theoretical material density. By using such formed bodies in glass manufacture, important advantages compared with using glass raw materials provided in a granular or powdery state may be achieved. The formed bodies do not release dust, whereby accumulation of dust inside the exhaust conduits may be avoided. The formed bodies can be melted more easily than powdery glass raw materials, with the result that a greater amount of glass per surface unit of the glass tub can be melted. Whereas a glass batch house is required when processing granular or powdery raw materials, the batch house may be eliminated when working with formed bodies. The formed bodies may also be manufactured in a location other than the glassworks and possibly be processed in various locations.

The previous proposals have, however, not found practical industrial application.

From DE 44 18 029 A1 it is known to manufacture formed bodies particularly in the form of pellet-type formed bodies comprised of a mixture of glass raw materials with waterglass as a binding agent and water, wherein the components are mixed and this mixture is pressed into compact formed bodies. In order to prevent the formed bodies, which are still humid after compression, from sticking together and make them suited for bunker storage, the formed bodies are coated with a dry substance such as soda and/or quicklime in a rotating drum and then packaged in sacks.

A first disadvantage herein resides in the fact that the durability of the formed bodies which is required for dumping into a large-volume silo container is reached only after a considerably long drying and setting period as the waterglass must first dry completely for crystallisation. This long sojourn time prior to the actual industrial storage in silo containers requires large intermediate storage or drier capacities.

It is a particular drawback for industrial production that such formed bodies bound with waterglass must directly be fed to the melting tub without pre-heating because the waterglass binding agent releases crystallisation water upon heating to more than approx. 350°C, which results in a volume increase of the formed bodies of approximately 30%. As a result, the formed bodies are jammed inside the pre-heating means, making a smooth, continuous pre-heating impossible. Having to manage without utilising the waste gas energy of the melting tub for pre-heating the raw material mixture brings about a considerable degradation of the energy balance of the industrial production facility. Formed bodies with waterglass bonding are consequently not suited for use in an industrial production facility where the technical equipment is designed for pre-heating and heat recovery.

It is the object of the invention to furnish formed bodies of glass-forming raw materials which may economically be used in a continuous industrial glass manufacturing process employing a melting tub and particularly employing continuous pre-heating of the raw materials. It is furthermore an object of the invention to propose a suitable method and a device for manufacturing these formed bodies.

The invention is founded in the insight that a binding agent based on clinker cement may successfully be used for the formed bodies if the formed bodies are concurrently compacted to have an apparent density amounting to at least 90% of the mixture's material density.

In terms of product technology, this object is achieved by the characterising features of claim 1.

The material density of the mixture referred to herein designates the density of a dry, non-porous body of this mixture, i.e. the maximum density attainable by adding together the densities of the dry substance proportions, whereas the apparent density expresses the relatively reduced apparent density of a dry formed body which includes pores. The theoretical maximum density of conventional glass-forming raw material is in the range of approximately 2.6 g/cm^3 to 2.7 g/cm^3. The apparent density of the formed bodies according to the invention thus amounts to approximately 2.3 g/cm^3 and more.

During hydration or hydroxide formation, respectively, clinker cement initially forms calcium aluminate crystals as a result of the entrance of humidity, with the solidification reaction occurring within about two to three minutes unless delayed by a suitable additive which delays setting. The calcium aluminate crystals are small crystals as a general rule not suited to generate effective binding forces between the particles of the glass-forming raw materials owing to their small sizes. In a second phase, elongated calcium silicates crystallise which are capable of bridging the gaps between particles owing to their elongated form, such that the particles are immobilised in their relative positions. The calcium silicates of the second phase, however, crystallise very slowly and are not sufficiently temperature resistant for a pre-heating of the raw materials, such that clinker cement cannot be regarded a suitable binding agent under this aspect.

Use of clinker cement in combination with the apparent density of the mixture, however, results in a surprising combined effect in the sense that even the small-sized calcium aluminate crystals of the first phase are capable, in view of the very small distances between the individual particles within the highly compacted material, of generating very high cohesive forces compared with less compact mixtures. Due to the high compacting degree of the material, the service durability is thus already attained in the first crystallisation phase of the clinker cement.

In this way the formed bodies attain a service durability sufficient for handling and further processing already immediately following pressing. In the course of further processing and heating by the exothermal hydration reaction or hydroxide formation and/or additional heat input, the second crystallisation phase of the calcium-silicate crystals is subsequently also formed, which are temperature resistant up to 400 to 450°C and thereby provide additional durability during handling and silo storage or on transport routes. In the process of pre-heating, performed at approximately 650°C, the cohesion of the calcium-silicate crystals is not available any more, however the calcium aluminate crystals of the first phase retain their binding effect even at pre-heating temperatures, for which reason problems do not occur during transport into the pre-heating means, while passing through the pre-heating means, and upon discharge from the pre-heating means. Pre-heating of the formed bodies concurrently causes the exhaust gas from the glass melting tub to be cooled down to temperatures of e.g. 300 to 350°C, thus enabling use of electrostatic filters for filtering the exhaust gases, such filters being usable only at temperatures below 400°C, for example.

Another advantage results from the fact that clinker cement is substantially made up of CaO, MgO and SiO_2 only, which means that noxious impurities like sulphur or the like are not introduced into the melting tub by the clinker cement. CaO, MgO and SiO_2 are substances also contained in the glass; consequently the proportions of these substances may be reduced in the raw material mixture for a predetermined glass composition to the extent in which they are substituted by the added clinker cement. Under the aspect of its composition, the clinker cement thus even comes to form part of the raw material mixture. Although the use of up to approx. 20% by weight of clinker cement is conceivable under this aspect, minimised substitution of substances in the raw material mixture with clinker cement, however, must be limited if only for cost reasons. Clinker cement moreover has a water/cement value of 0.25, which means that one weight part of water must be added to four weight parts of clinker cement for the purpose of hydration. Approximately the same amount of excess or lost water must be added, which does not contribute to hydration but initially remains at the particle surfaces and only gradually dries off. At high clinker cement proportions, this results in a limitation of the achievable apparent density owing to the fact that the entire water volume must initially be received into the pores of the formed body during pressing. If, for example, an apparent density of 95% of the material density is desired, then the addition of water must equally not exceed 5%, for it would in this case restrict the proportion of clinker cement to the order of 10% when taking into account the 50% proportion of loss water. This has, in turn, been found to be sufficient in order to attain the service durability of the highly compacted formed body already through the calcium aluminate crystals of the first phase.

High compression is moreover advantageous because it simultaneously achieves the effect of additionally crushing and mixing the glass-forming raw material constituents. This crushing and mixing effect results in even further improved melting behavior of the formed bodies.

With a higher compacting degree of the formed bodies the solubilising behavior exerted by the low-melting constituents on the higher-melting ones, such as quartz sand, further improves.

A particular advantage is derived from the high apparent density in that the air or gas proportion in the formed body, which impedes propagation of the heating front to the interior of the formed body in the melting tub, is minimised. In this way the melting of the highly compacted formed bodies takes place considerably more rapidly than in the case of less compacted formed bodies including a high air proportion. This not only prevents segregation of the starting materials in the melting tub, which might result in material "islets" in the melting tub which are difficult to melt, but at a given dwelling time in the melt also prolongs the refining time and thereby improves the glass quality.

These latter effects are known from DE 25 13 082 A1 which teaches to produce in a roll gap a continuous layer or web of mixture having an apparent density of preferably 90 to 95% of the material density, with this web starting out from the roll gap and passing over guiding means to be continuously charged into the melting tub in the form of a large-surface panel. As the web, following compacting, will essentially not be further exposed to mechanical forces, a binding agent may be omitted altogether. Such a manner of proceeding, however, naturally excludes any further possibility of pre-heating the raw material and of heat recovery. It furthermore prohibits any possibilities of producing raw material suited for charging into the tub at a site removed from the tub, its intermediate stocking in accordance with necessity etc. Centralised manufacture of materials ready for charging and their economical use at a plurality of melting tubs in various production sites is consequently also ruled out. By using clinker cement as a binding agent for such highly compacted material, the technologically advantageous effects of the teaching of DE 25 13 082 A1 can thus for the first time successfully be attained if the advantages of pelletted or briquetted raw material and in particular of raw material pre-heating or heat recovery are to be attained as well.

The subject matter of the invention furthermore concerns a method for producing such formed bodies, wherein the glass-forming elements of the clinker cement are taken into account in quantification of the various glass-forming raw materials in the mixture, water is added in a proportion of 2 to 10% (wt.), and the formed bodies are pressed to reach an apparent density of at least 90% of the material density.

If the mixing process prior to pressing exceeds a duration of two to three minutes following the addition of water, then hydration of the first phase must be delayed to prevent the mixture from lumping even prior to pressing, which would make its handling impossible. For the purpose of delaying setting, additives delaying setting are known in the cement industry. What is ideal is an additive delaying setting which, in the interstitional time period between the addition of water and pressing, largely prevents formation of the calcium aluminate crystals of the first phase, then however rapidly permits their full formation. It was found that excellent suitability as an additive delaying setting occurs in a mixture of citric acid and sugar provided in a ratio of 5 : 1 in mixture and added to the cement in the solid form in an amount in the order of a few parts per thousand in weight (dry) in relation to the cement. Hereby solidification delay times in the order of e.g.

20 minutes may be adjusted, with the hydration reaction or hydroxide formation being initiated upon pressing as a result of the heat generated by internal friction, and service durability already being reached after approximately two hours.

The subject matter of the invention furthermore concerns a device for producing such formed bodies which comprises a mixer for forming a mixture of glass-forming raw materials, clinker cement and water, feeding means, and a roll press for pressing the mixture into formed bodies.

The formed bodies of the invention should have limited dimensions in order to favor homogeneous pre-heating. They preferably have a maximum weight of 500 g, the weight of the formed bodies preferably is between 10 and 200 g, in particular 30 and 60 g. The formed bodies may have any desired shape, i.e. for example spherical or elongate.

The preferred shape is the shape of an ovoid having a length of approx. 20 to 50 mm and a thickness of 15 to 25 mm.

Forming smaller formed bodies increases the specific surface thereof, whereby the melting properties are improved. Pre-heating equally improves for smaller formed bodies. On the other hand, the formed bodies should not be of such a small size as to result in insufficient passage of air flow through a layer of formed bodies, or in a flow resistance which is too high for the passage of the tub exhaust gases used for pre-heating.

For producing the formed bodies, the usual glass-forming raw materials can be used in a granular or powdery state. Fragmented mineral wool waste as well as fragments from formed bodies, which are derived by sifting possibly performed at a downstream position, can equally be incorporated into the formed bodies.

The glass-forming raw materials for producing the formed bodies preferably have grain sizes of 0.1 to 5 mm, preferably 0.1 to 3 mm. A certain amount of fine-grain starting material is advantageous.

The clinker cement is preferably used in an amount of 3 to 15% (wt.) in relation to the mixture, and particularly 10 to 12% (wt.). With these binder proportions, formed bodies having optimum stability may be produced.

The mixture for producing the formed bodies furthermore includes water, with the water content of the mixture preferably amouting to 2 to 10% (wt.) and particularly 2 to 6% (wt.). A water content of approx. 4% (wt.) was found to be particularly advantageous.

It is preferred to subject the formed bodies to a heat treatment for solidification. The heat treatment is preferably carried out at 50 to 200°C, in a preferred manner 50 to 150°C, in particular 60 to 80°C. This elevated temperature range is made particularly advantageous use of because in the method of the invention the gain in durability is preferably obtained through formation of the calcium aluminate crystals, whereas the formation of the calcium silicate crystals is suppressed at such temperatures.

In the formed bodies of the invention, a relatively small amount of water is added to the mixture, namely as mentioned above, preferably 2 to 10% (wt.) in relation to the mixture. This small amount of water does not result in the formation of cement paste; rather, the result is a mixture having a low humidity content which may be termed "dampness". This damp mixture can be compacted into formed bodies in a very short time in compacting means such as a roll press.

Heat treatment of formed bodies shaped from the damp mixture is carried out while avoiding to extract humidity as far as possible. The duration of the heat treatment is for example 30 to 360 minutes and preferably 60 to 120 minutes. In the heat treatment not more than 50% (wt.), preferably not more than 10% (wt.) of the water should be extracted from the formed bodies.

The heat treatment is preferably carried out in a steam atmosphere, in particular in a saturated steam atmosphere, in order to avoid water losses.

The heat treatment results in a shortened setting time.

The heat treatment further results in a strong solidification of the formed bodies. The formed bodies may subsequently be heated to the sintering temperature and even further without falling apart.

In accordance with a preferred embodiment the formed bodies are calcinated, i.e. subjected to another heat treatment at approx. 700 to 900°C, preferably at approx. 850°C. Upon calcination, the carbon dioxide of the carbonate components of the glass escapes and the formed body loses approximately 30% of its weight.

Use of calcinated formed bodies results in increased throughput in the melting tub.

For pressing the formed bodies, preferably a roll press, in particular a roll briquetting press is used whereby very high apparent densities of more than 90% of the theoretical material density may be obtained. Upon pressing to such high densities the components of the formed body are brought into very intimate mutual contact. The water, owing to its incompressibility, is distributed very finely inside the formed body. As a result of the internal friction inside the formed bodies there furthermore already occurs a considerable heating which supports hydraulic bonding.

Subsequently the formed bodies are preferably subjected to the described heat treatment. The formed bodies are then ready for use, i.e. they have a sufficient hardness to be filled into silos, transported across conveyor belts, or directly supplied to the glass melting furnace.

As mixing the glass-forming raw materials, the hydraulic binding agent and the water, pressing the formed bodies, and the heat treatment of the formed bodies only require a relatively short time, the method of the invention may be carried out continuously.

When a roll press is used, the mixture may be supplied to it in controlled amounts via conveyor screws. It is also conceivable to directly supply the mixture to the roll press and to control the amounts by means of the gap width of the roll press.

Apart from the mixer for forming the mixture of glass-forming raw materials, clinker cement and water, feeding means and a roll press for pressing the mixture into formed bodies, the device of the invention for producing the formed bodies preferably also includes means for the heat treatment of the formed bodies.

The heat treatment of the formed bodies is for example carried out inside a container part of which is coursed through by a heated air flow. The container preferably comprises at its upper end a charging port for the formed bodies to be heated, and at its lower end a port for withdrawing the formed bodies which have undergone the heat treatment. The portion through which the heated air flows is formed by the lower region of the container. The heated air is preferably guided in a closed hot-air circuit. The water evaporated by the heated air rises inside the bulk material in the container, whereby the water vapor in the region of the upper and colder formed bodies condenses and becomes available for their hydration. The humidity of the formed bodies is thus largely maintained.

Preferably at the same time, the container is supplied with fresh formed bodies, and to the same extent, formed bodies having undergone the heat treatment are withdrawn, whereby a continuous throughput is created and the container always remains filled.

After the heat treatment the formed bodies can be transported and filled into silos to be stored there.

The formed bodies may be heated up to the sintering temperature or to calcination without disintegrating. The formed bodies are preferably pre-heated to a temperature of approximately 650 to 700°C by the hot fumes of the glass melting furnace and in a given case calcinated at approximately 850°C in another process step by additional heat input from a heat source located externally of the melting tub. Hereby the heat content of the glass melting furnace exhaust gases is made use of and essential energy savings are achieved.

The feeding means of the device for producing the formed bodies is preferably of the gravitational feeding type, wherein the mixture is directly supplied to the roll press, i.e. the mixture is fed onto one of the rollers, which comprises integrally rotating flange disks as lateral retaining elements.

The device of the invention and the method of the invention are explained below in further detail by referring to the drawing which shows exemplary, preferred embodiments, wherein:

Fig. 1 is an overall schematic representation of the device,

Fig. 2 shows an embodiment of a roll press, and

Fig. 3 is a planar view of the roll press according to Fig. 2.

The glass-forming raw materials are stored in containers 1 to 4. They are supplied in desired ratios via conveying means 5 to a mixer 6 to form a mixture of the glass-forming raw materials, clinker cement and water. The mixer 6 is for this purpose provided with a water supply conduit not shown here. In the same manner, dust from formed body production and from the melting tub operation as well as waste material from the mineral wool production may be supplied to the mixer.

From the mixer 6, the mixture is fed into a roll briquetting press 8 by a conveyor belt 7. The device includes a charging hopper 9 including one or several conveyor screws, only one screw 10 of which is represented.

The conveyor screw 10 supplies the mixture in controlled amounts to the rolls 12, 13 of the roll briquetting press 8. At the upper end of the hopper 9 a level detector 11 is provided which controls the continuous operation.

The narrowing bottom end of the hopper 9 to which the conveyor screw 10 transports the mixture extends in between the two rolls 12, 13 which are represented idling in the drawing, i.e. moved apart, which are, however, in pressurised contact during operation.

In accordance with a preferred embodiment shown in Figs. 2 and 3 which are simplified such as to show only only one row of briquetting molds, controlled amounts of the the material are charged directly onto one of the rolls. From the hopper 9 the mixture is transported via the feeding means 31 to the roll 13.

Instead of rigid, central guiding elements, lateral retention for the rolls is preferably provided by two flange disks 32, 32'.

Central guiding elements impede transport of the material such that material supply is partly insufficient in the marginal area and the desired density is not attained. The integrally rotating flange disks 32, 32′ solve this problem such that formed bodies having a high density and durability may be produced at low wear over the entire roll width.

In the embodiment according to Fig. 2, controlled amounts of the mixture to be compacted are charged onto the zenith area of the roll 13 which is provided with the flange disks 32, 32′. The roll transports the material into the press gap. By means of the gap width the amount of material is adjusted. The advantage of this embodiment resides in the particularly simple structure and in the fact that wear or clogging cannot occur during charging, i.e. proportioning is here effected by the gravity of the very mixture to be compacted.

The shell of each one of rolls 12, 13 is provided with molding depressions. The rolls 12, 13 are positioned in relative angular positions such that two molding depressions of one and the other roll 12, 13 meet in the roll gap at identical rotational velocities, and the mixture is pressed into ovoid-type formed bodies 14.

Below the rolls 12, 13 a strainer 15 is arranged through which non-compacted material drops onto a conveyor belt 16 and which, via conveying means 17 and the conveyor belt 7, is again supplied to the roll briquetting press 8. The formed bodies 14 are supplied from above by conveying means 18 to a container which is in the present case subdivided into five zones 20 to 24.

Distribution of the formed bodies 14 to the single zones 20 to 24 is performed by means of a translatable conveyor belt 25.

In the zones 20 to 24 the damp formed bodies 14 are subjected to a heat treatment in order to achieve setting. For this purpose the lower region of zones 20 to 24 is ventilated by hot air circulated via a conduit 26 which comprises heating means 27, preferably supplied with recycled heat, and a fan 28.

Via a conveyor belt 29 the cured formed bodies 14 are supplied to the melting tub or to intermediate means such as stocking silo, pre-heating means or calcinating means.

Claims

1. Formed body obtainable by compacting a mixture based on granular or powdery glass-forming raw materials, inorganic binding agent and water,

   characterised

   by substantially clinker cement as a binding agent and

   by an apparent density amounting to at least 90% of the theoretical maximum material density of the dry mixture.

2. Formed body according to claim 1, characterised in that the apparent density of the formed body amounts to 93 to 96%, in particular 94 to 95% of the material density.

3. Formed body according to claim 1 or 2, characterised in that the weight of the dry formed body is at most 500 g, in particular 10 to 200 g.

4. Formed body according to claim 3, characterised in that the weight of the dry formed body is 20 to 150 g, preferably 30 to 60 g.

5. Formed body according to one of claims 1 to 4, characterised in that the formed body presents dimensional stability up to at least 650°C.

6. Formed body according to one of claims 1 to 5, characterised in that it was subjected to calcination.

7. Method for producing formed bodies according to one of claims 1 to 6, wherein the proportions of glass-forming constituents of the clinker cement are taken into account in quantification of the various glass-forming raw materials in the mixture, the water is added in a proportion of 2 to 10% (wt.) in relation to the mixture, and the formed bodies are pressed to have an apparent density of at least 90% of the theoretical maximum material density.

8. Method according to claim 7, characterised in that the clinker cement is added in a proportion of 2 to 10% (wt.) in relation to the mixture.

9. Method according to claim 8, characterised in that the clinker cement is added in a proportion of 3 to 15% (wt.) in relation to the mixture.

10. Method according to one of claims 7 to 9, characterised in that the water is added in a proportion of 2 to 6% (wt.), in particular 2.5 to 4.5% (wt.), in relation to the mixture.

11. Method according to one of claims 7 to 10, characterised in that the formed bodies are subjected to a heat treatment after pressing.

12. Method according to claim 11, characterised in that the heat treatment is carried out at 50 to 200°C, in particular at 60 to 80°C.

13. Method according to one of claims 10 to 12, characterised in that the heat treatment is preferably carried out for 30 to 360 minutes.

14. Method according to one of claims 10 to 13, characterised in that the heat treatment is carried out in an atmosphere nearly saturated with water vapor.

15. Method according to one of claims 10 to 14, characterised in that not more than 50%, preferably not more than 10% of the water are withdrawn from the formed body during heat treatment.

16. Method according to one of claims 7 to 15, characterised in that the formed bodies are subsequently subjected to calcination.

17. Method according to one of claims 7 to 16, characterised in that the formed bodies are pressed in a roll press.

18. Method according to one of claims 7 to 17, characterised in that the mixture is directly supplied to the roll press, and that proportioning is controlled by means of the gap width of the roll press.

19. Method according to one of claims 7 to 18, characterised in that the setting characteristics of the clinker cement are influenced by an additive which delays and/or accelerates setting.

20. Device for producing formed bodies according to one of claims 1 to 6, including a mixer (6) for forming a mixture of glass-forming raw materials, clinker cement and water, feeding means (7, 10, 31) and a roll press (8) for pressing the mixture into formed bodies.

21. Device according to claim 20, characterised in that the device further includes means for heat treatment (20 to 24) of the formed bodies.

22. Device according to claim 21, characterised in that the means for heat treatment (20 to 24) of the formed bodies comprises an atmosphere nearly saturated with water vapor.

23. Device according to one of claims 20 to 22, characterised in that the feeding means has the form of a conveyor screw (10).

24. Device according to one of claims 20 to 22, characterised in that the roll (13) of the roll press (8) is supplied by gravity feeding.

25. Device according to one of claims 20 to 24, characterised in that the roll (13) of the roll press (8) includes flange disks (32, 32').

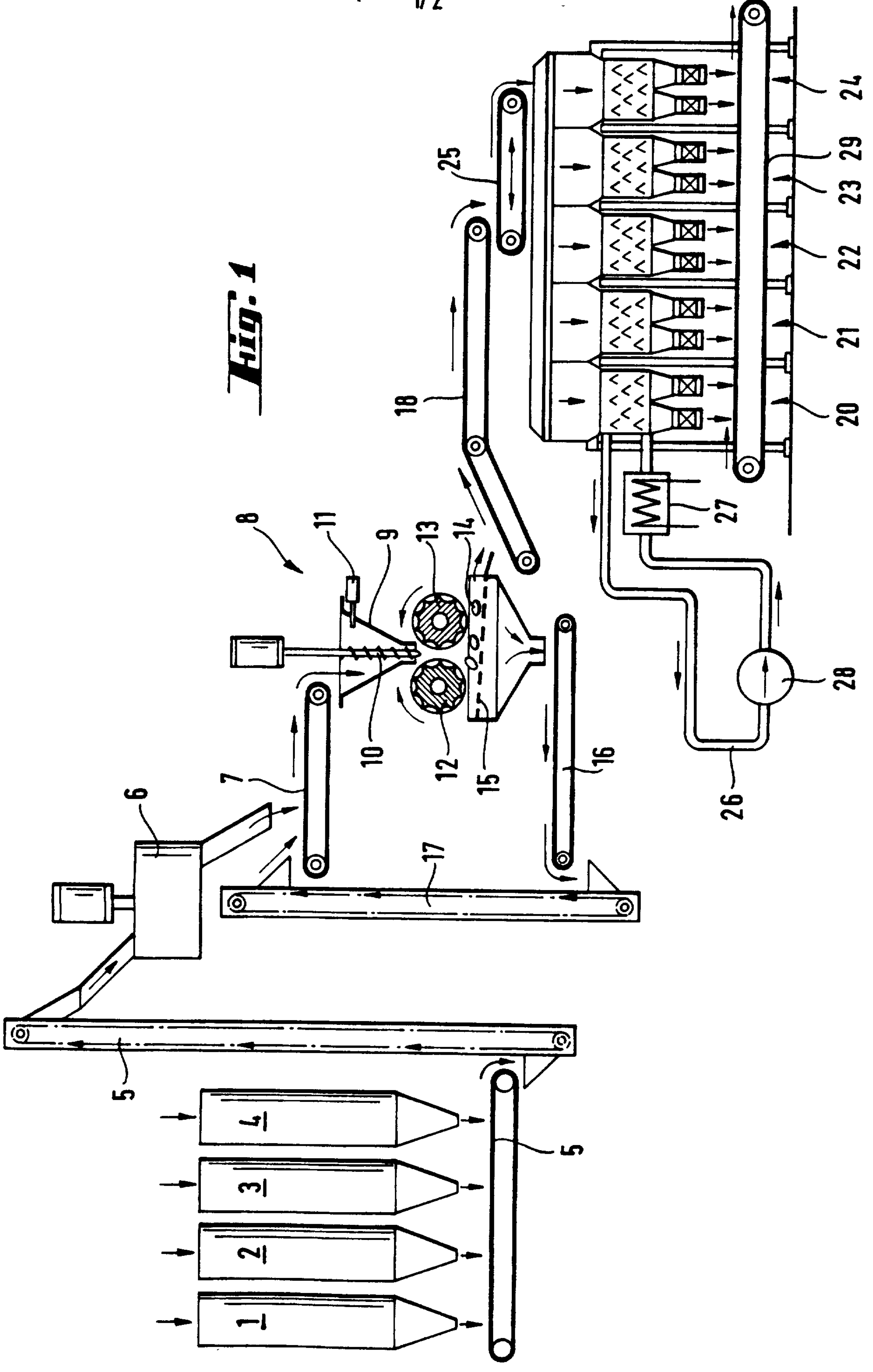
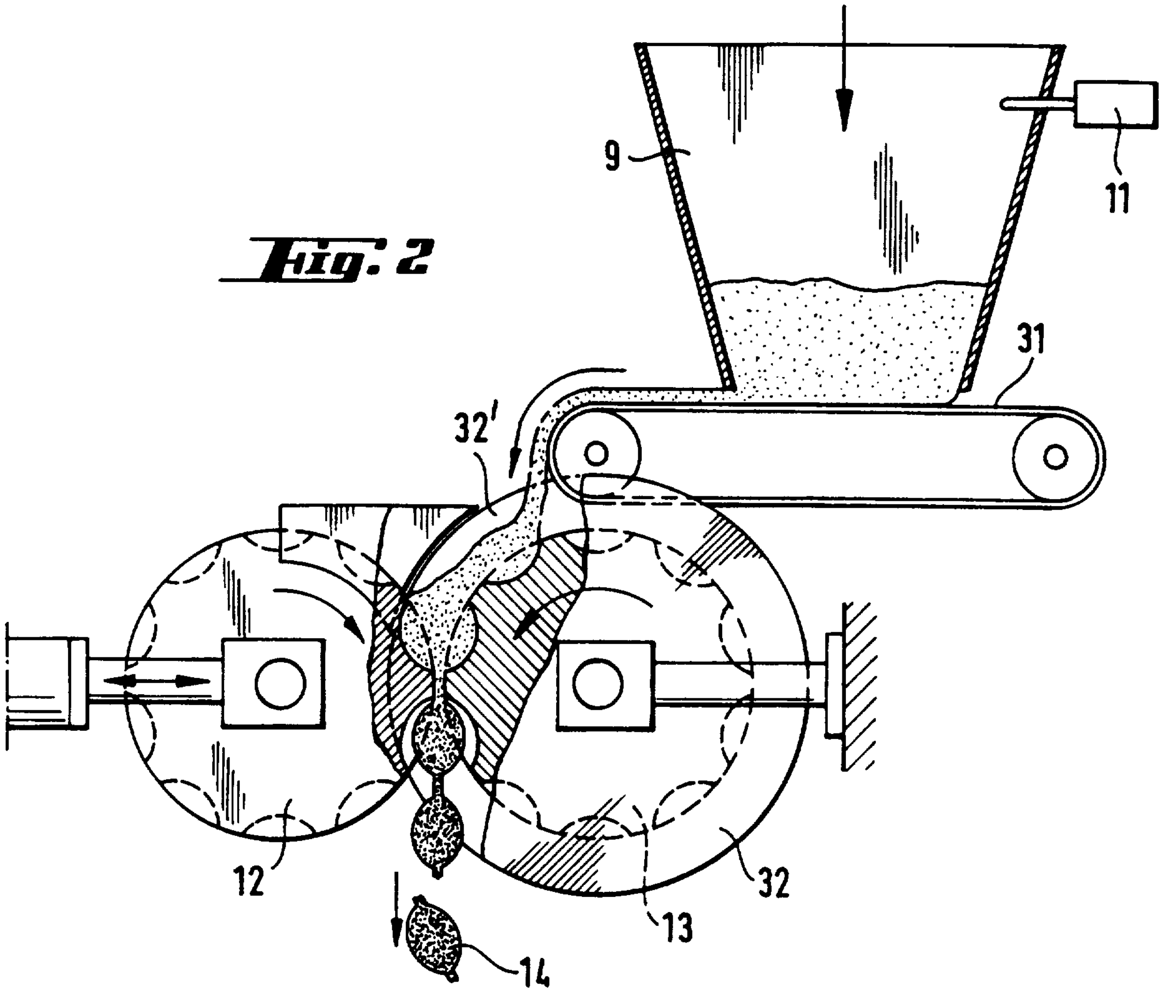


Fig. 1

Fig. 2



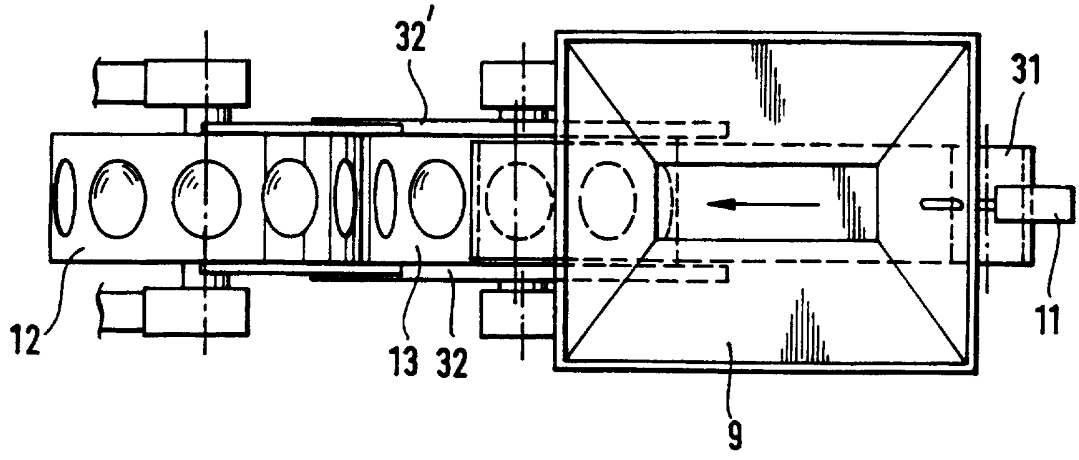


Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 97/00023

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C03C1/02 C03B1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C03C C03B B28B B30B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 487 (C-649), 6 November 1989 & JP 01 192743 A (NIPPON STEEL CHEM. CO., LTD.), 2 August 1989, see abstract ---	1,7
A	US 4 287 142 A (K.HOLBEK) 1 September 1981 see the whole document ---	1,7
A	CHEMICAL ABSTRACTS, vol. 67, no. 18, 30 October 1967 Columbus, Ohio, US; abstract no. 84576, XP002029202 see abstract & SE 205 247 B (ROCKWOOL AB) 7 June 1966 --- -/--	1,7

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

2

Date of the actual completion of the international search	Date of mailing of the international search report
10 April 1997	21.04.97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+ 31-70) 340-3016	Stroud, J

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	DE 41 22 334 A (ZEMENTANLAGEN- UND MASCHINENBAU GMBH) 7 January 1993 see claims 1,4,6,8,10,14,16	20,21,23 1,7
A	CHEMICAL ABSTRACTS, vol. 86, no. 4, 24 January 1977 Columbus, Ohio, US; abstract no. 20938, XP002029203 see abstract & SE 7 405 368 A (GLASTEKNISK UTVECKLING AB) 24 May 1976 see page 2 - page 3	1,7,19
A	WO 92 04289 A (B.L.O.TALLING ET AL.) 19 March 1992 see the whole document	1,7
A	CHEMICAL ABSTRACTS, vol. 81, no. 10, 9 September 1974 Columbus, Ohio, US; abstract no. 53663, XP002029204 see abstract & JP 49 009 515 A (K.KAWAI) 28 January 1974	1,7
A	AMERICAN CERAMIC SOCIETY BULLETIN, vol. 52, no. 8, August 1973, COLUMBUS US, pages 617-620, XP002029199 W.H.MANRING ET AL.: "THE BATCH PREPARATION PROCESS - PAST, PRESENT AND FUTURE" see page 618, right-hand column - page 619, left-hand column	1,7
A	FR 2 266 663 A (SAINT-GOBAIN IND.) 31 October 1975 cited in the application see the whole document	1,7
X Y	GB 2 011 376 A (KLÖCKNER HUMBOLDT DEUTZ AG) 11 July 1979 see the whole document	20-24 25
Y	FR 0 775 328 A (SOCIETE NOUVELLE DES USINES DE LA CHALEASSIERE) 26 December 1934 see figures 1,3,4	25
X	FR 0 923 531 A (OWENS-CORNING FIBERGLAS CORP.) 9 July 1947 see the whole document	20,21,24

2

-/--

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GLASS INDUSTRY, vol. 64, no. 12, December 1983, NEW YORK US, pages 14-17, XP002029200 J.R.BROWN: "DOES IT PAY TO COMPACT BATCH?" see the whole document ---	20,21,23
X	GLASS INDUSTRY, vol. 68, no. 4, March 1987, NEW YORK US, pages 21-23, XP002029201 J.M.ALEXANDER ET AL.: "advanced sodium silicate glass-melting technology" see the whole document ---	20,21,24
X	PATENT ABSTRACTS OF JAPAN vol. 13, no. 241 (C-604), 6 June 1989 & JP 01 051333 A (NSG CO., LTD.), 27 February 1989, see abstract ---	20,21,24
Y	DE 04 82 786 C (MASCHINENFABRIK FR. GRÖPPEL) 20 September 1929 see figures 1,2 ---	25
Y	US 5 073 323 A (H.A.MCCARTNEY) 17 December 1991 see figures 2,4,5 ---	25
Y	GB 0 532 694 A (BIBBY & SONS LTD.) 29 January 1946 see figures 2,5 -----	25

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 97/00023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4287142 A	01-09-81	NONE	
DE 4122334 A	07-01-93	AT 140689 T DE 59206802 D EP 0526697 A SK 204592 A	15-08-96 29-08-96 10-02-93 09-11-94
WO 9204289 A	19-03-92	AU 8424691 A EP 0546000 A PL 168487 B US 5472917 A	30-03-92 16-06-93 29-02-96 05-12-95
FR 2266663 A	31-10-75	BE 827538 A DE 2513082 A GB 1449439 A	03-10-75 09-10-75 15-09-76
GB 2011376 A	11-07-79	DE 2759021 A BE 873252 A FR 2413329 A JP 54100411 A US 4238217 A	12-07-79 17-04-79 27-07-79 08-08-79 09-12-80
FR 0775328 A	24-12-34	NONE	
FR 0923531 A	25-07-47	BE 463858 A CH 269458 A GB 663855 A NL 77146 C US 2578110 A	 11-12-51
DE 0482786 C		NONE	
US 5073323 A	17-12-91	NONE	
GB 0532694 A		NONE	