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(54) INSULATING PRODUCT OF MINERAL FIBRE WOOL, INTENDED IN PARTICULAR FOR HEAT INSULATION OF PIPES, AND METHOD FOR MAKING THIS PRODUCT

DÄMMSTOFF AUS MINERALWOLLE FÜR DIE RÖHRENWÄRMEDÄMMUNG UND VERFAHREN ZUR HERSTELLUNG

PRODUIT ISOLANT EN LAINE DE FIBRE MINERALE, DESTINE EN PARTICULIER A L'ISOLATION THERMIQUE DE CONDUITES ET PROCEDE DE PREPARATION D'UN TEL PRODUIT

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Description

[0001] The present invention relates to an insulating product of mineral fibres intended in particular for the heat insulation of pipes. The product shall have a good temperature resistance, moisture resistance and a strength that resists a high temporary load, e.g. the steps of the pipe fitter on the pipe during installation operations. The insulating product shall be shapeable at once or later to the desired shape and subsequently curable at the prevailing outer temperature or at a raised temperature.

[0002] In view of an economically optimal production of the product, the production shall be feasible in a conventional installation for the production of mineral wool webs. The curing temperature shall be adaptabe to the circumstances and the curing time shall be short.

[0003] The Finnish patent specification 67751 discloses the production of insulating bodies based on mineral wool. In order to achieve the desired compression resistance and temperature resistance, clay sludge, preferably bentonite, is absorbed by means of under-pressure into a preshaped and cured tubular bowl or insulating plate. The process requires a curing of several hours in a furnace. The insulating body has a good temperature resistance, of at least 800°C, but is expensive owing to a slow and costly production process and expensive raw material. An additional drawback of the bentonite body is its coarse surface, requiring an additional surface treatment, i.e. milling, thus increasing the price of the material.

[0004] Phenol cured insulating bodies are also known. Phenol is a fairly cheap and rapidly curing binder. A phenol cured product resists temperatures of up to 250°C, but if the temperature is above 250°C for a long period of time, the bonds are destroyed. At higher temperatures, of 400°C and more, the binder residues flare up, the temperature rises rapidly and the product collapses. Another drawback of phenol insulating bodies consists in their emitting poisonous gases during burning.

[0005] The SE lay-out print 420 488, for instance, discloses the use of a mass based on water glass and clay mineral substances as a binding agent. The binder provides a good water and heat resistance in the product. On the other hand, the product has a poor compression resistance, meaning that e.g. a tubular bowl made of mineral fibres and treated according to the layout print does not resist temporary load. Moreover, the product is brittle and thus causes dusting.

[0006] From DE-C2-28 04 069 a method of producing an insulating product is known where mineral fibers are bound together by water glass, but no slag or other hydraulic bond forming material is used.

[0007] SU 614061 discloses an insulating product comprising at least 35 wt-% of perlite sand and optionally up to 20 wt-% of kaolin fibers (not mineral fibers) where the binder consists of synthetic Al-Ca-slag and water glass.

[0008] DK-C-69522 relates to a stiff insulating material of mineral wool, e.g. slag wool, which is impregnated with water glass and subsequently heated so that the water glass is transformed to a foam whereafter the material is cooled.

[0009] GB-A-457 842 relates to an insulating product consisting e.g. of slag wool which is impregnated e.g. with an alkaline or potassium salt in such proportions that a silica gel is formed and a portion of the silicate remains free to combine separately with the slag wool. Here water glass does not act as an activator of slag.

[0010] SU 622781 discloses a fire-resistant **coating** containing mainly mineral fiber (30-60 wt-%) and water glass (30-50 wt-%).

[0011] US 2 904 444 is related to an insulating material of calcium hydroxide and diatomaceous earth. The material does not contain mineral wool nor is it treated with water glass.

[0012] CH-A5-238299 relates to a **coating agent** containing water glass and slag wool (preferably in the proportion 3:1).

[0013] According to the present invention, it has been noted that an insulating product can be achieved, which is especially suitable as a tubular bowl, out of a mineral fibre web prepared in a conventional manner by using as a binding agent a water glass based binder with an addition of slag.

[0014] The main characteristics of the invention appear from the characterizing parts of claims 1 and 6.

[0015] The slag imparts many valuable properties to the insulating material. The alkalis of the water glass act as activators of the slag (cf. slag alkali cement). Together with water glass, slag forms a hydraulic bond giving the cured product an improved compression resistance, a reduced brittleness and thus reduced dusting and greater dust particles, compared to products treated with binders containing water glass without a slag addition.

[0016] Moreover, a good temperature resistance is achieved in a product containing a binder based on water glass and having a slag addition. Due to the hydraulic bond of the slag to the water glass, the water is firmly bound, chemically bound to the structure. The chemically bound water increases the fire-resistance capacity of the material in that the water evaporating at a fire temperature keeps down the temperature for a longer period. A water glass based binder resists a long-lasting temperature charge of up to 800°C.

[0017] Combined with the water glass, the slag increases the crystallinity of the material, thus reducing the moisture absorption tendency and the moisture sensitivity.

[0018] Moreover, a more rapid curing and the possibility of optional curing conditions are provided. The curing time

for a product containing water glass and slag in the binder and by using conventional curing in a curing chamber is approx. 20-60 s for thin products and approx. 20 min. at the most for thick tubular bowls. Equally good curing times are achieved with phenol containing binders, but these binders are unsuitable in other respects. Other known binders require curing times of up to several hours.

[0019] Another advantage of the system water glass/slag is that the binder enables the forming of no-swelling compounds, although the temperature exceeds the swelling temperature of pure water glass, 160°C.

[0020] Further advantages of the slag is its reactivity at a normal temperature. This means among others that the slag totally prevents carbonation, which is a noticeable advantage. Other mineral curing agents, like fly ash and clay, do not possess this property. Clay and corresponding substances mainly act as fillers.

[0021] It has been noted according to the invention, that the advantageous effects of slag are achieved with relatively small amounts of slag, both with regard to the amount of water glass and to the amount of fibres. In the binder, the weight ratio of the dry substance of the water glass to the slag is 100:1 - 100:50, preferably 10:1 - 10:2. In the product, the weight ratio of the mineral fibre amount to the dry substance of the water glass is 100:1 - 100:20, preferably 100:5 - 100:15.

[0022] The slag of the binder is preferably blast furnace slag.

[0023] The slag/water glass system is well controllable and thus provides a geat flexiblity for the method of preparing an insulating product of mineral wool. Controllable components are among others:

slag	water glass (VG)	curing conditions
slag chemistry	type of VG	temperature
slag mineralogy	molar ratio	time
grinding fineness	modifier	environment (moisture)
particle distribution modifier slag amount	VG compositions	

[0024] Knowledge of the behaviour of various slags in an alkaline environment enables the control of the properties of the final product.

[0025] The slag reacts with the alkalis of the water glass, i.e. it is activated. Thus, water resistant hydrate phases of a zeolite type are obtained. Owing to this mechanism, the molar ratio R_s (the ratio of the silicon moles to the alkali moles in the water glass) for the residual unreacted water glass rises so much that also this residue becomes water resistant. A higher alkali content, i.e. a lower molar ratio R_s, requires a higher slag portion in order to tie up the alkalis in a water resistant form.

[0026] The molar ratio R_s of commercial water glass is approx. 3.3. According to the invention, it has been observed that very low molar ratios are also usable, requiring in that case high slag contents in order to provide water resistance of the final composite. Even NaOH or Na_2CO_3 are usable. However, it is preferable to use the molar ratio $R_s \geqq 2.3$. The optimal moisture resistance with regard to the reactivity with slag is obtained for R_s = 2.7-3.0.

[0027] The main components of the slag-glass are CaO, MgO, SiO_2, Al_2O_3. It is generally true about slag/water glass systems that the lower the CaO content, i.e. the ratio CaO/SiO_2, the lower a molar ratio R_s should be used in order to obtain a hydraulic bond within a reasonable period of time. When using low molar ratios, $R_s \leqq 2.7$, the slag content has to be increased. With a higher ratio $CaO/SiO_2 \geqq 1.3$, water glass can be used with $R_s \geqq 3.3$, still obtaining a sufficient reactivity.

[0028] The reaction degree is controlled by means of the temperature and the curing time. A higher curing temperature shortens the curing time and vice versa.

[0029] A lower R_s shortens the curing time at a constant temperature. A higher R_s requires a longer curing time or a higher temperature.

[0030] By prereacting slag with water glass at a normal or a raised temperature under agitation, the reaction degree and the curing rate can be further increased. A finished hydrate phase is consequently created, speeding up the curing when the binder has been applied onto the mineral wool.

[0031] In case the curing temperature exceeds approx. 160°C, the slag content has to be increased in order to prevent the water glass from swelling (cf. slag alkali cement).

[0032] Trituration of the slag increases the reaction rate and the reactivity. This enables to use a water glass with a higher R_s, or optionally a very rapid curing can be ahieved at a lower R_s. A finely ground slag also improves the stability of the slurry of water glass and slag.

[0033] The water glass can be a sodium, potassium, lithium or ammonium silicate solution. In case the slag content

is high, hydroxides and/or carbonates can be added.

[0034] The preparation of a mineral wool product and the addition of the binder based on water glass and containing slag takes place conventionally in a conventional set of apparatus. The binder is added as a solution through a nozzle to the fibres in the wool chamber of a conventional machine line. The water glass and the slag are premixed in water and are kept in agitation before the distribution on the wool. The curing of the binder mixed wool material takes place at once or later, at room temperature or at a raised temperature.

[0035] Besides water glass and slag, the binder solution can contain possible additional curing, modifying, dust binding and/or hydrophobing agents.

[0036] The spraying of the binder solution and the additives takes place directly after the fibre formation, preferably in the wool chamber. This is an essential advantage, since the wool is in a virginal state here and thus has a good adhesiveness.

[0037] The binder composition is sprayed on the wool through the binder nozzles of the centrifuge, both peripheral and central sprayers being then usable. Optionally two different solutions can be fed into the wool, so that possible modifying and/or additional curing agents are fed through the one sprayer and a slurry of water glass/slag + possible modifying agents through the other sprayer.

[0038] An additional binder solution can appropriately be added to the wool in a subsequent step of the production of the insulating material. By applying more binder solution on the primary web, a composite having a better resistance is achieved. By adding additional additives on the primary web special properties can be given to the material.

[0039] Before the feeding of the binder only compatible substances need to be premixed, whereas the other necessary additional components are mixed only at the moment of application. The mixing can be carried out for instance by rapid mixing, e.g. in tubular mixers. Thus the dwell time will be short enough not to allow any gelling or precipitating reactions to take place. The required additional water is also adjusted by feeding into the rapid mixer. The water amount is adjusted so as to provide the correct moisture for the primary web and prevent dusting. The water evaporation taking place in the wool chamber increases the viscosity of the binder composition applied onto the fibre. The high viscosity means a very low ion migration, thus decreasing the reaction rate. In this manner, the primary web retains its elasticity and curability for several days/weeks, provided that further water discharge is prevented.

[0040] When producing insulating sheets, these are appropriately cut out from a mineral web, which has been conventionally laid out by oscillating to the desired thickness and then cured.

[0041] According to a preferred method, the mineral fibre web is cured at room temperature, for instance between metal sheets. Thus the sheet will acquire a better flexibility. A slowly cured fibre body is, as is known, more flexible, elastic, than a fibre body that has to be cured at a high temperature.

[0042] According to another preferred embodiment a secondary web having the desired thickness is taken up in an uncured state and stored in a non curing environment, e.g. enclosed in plastic at a suitable temperature and during a determined time at the most. This insulating material is used in situ for the insulation in places that are not easily accessable and have an awkward shape, such as for instance renovation objects. Afterwards, the insulation cures at the prevailing temperature. It is relatively easy to apply an insulating mat having a suitable thickness onto or around various bodies difficult to access. The curing does not require any special measures or equipment since it takes place spontaneously at the prevailing temperature.

[0043] The method is also suitable for blow wool applications, in which uncured fibre material torn into small tufts is applied onto pipes, where the wool can be cured at the prevailing temperature.

[0044] When producing tubular bowls, a secondary web is shaped to the desired shape of a tubular bowl, and is subsequently cured in a known manner. The curing can take place rapdily at a high temperature or slower at a lower temperature.

[0045] Additional additives, like additional curing, modifying, dust binding and hydrophobizing agents cooperate with the water glass/slag system.

[0046] According to the invention, the additional curing agents consist of mineral salts and compounds, suitable acids, esters or alcohols or of combinations of these. The mineral salts can be e.g. magnesium, aluminium or calcium salts or compounds. Phosphoric acid, for instance, is a usable acid. Buffer curing agents can also be used for adjusting the storage time. The additional curing agent may be a combination of the above mentioned curing agents.

[0047] For the water glass, various modifying agents like organic and unorganic polymers, cellulose and silicones like silicon organic polymers are appropriately used. Also monomers polymerized by e.g. a pH change or a temperature rise during the curing can be used. The modifying agents of water glass have in common the fact of not being film forming. By means of the modifying agents one aims at softening the water glass, thus increasing its adhesiveness to the fibre surface.

[0048] The water glass modifier improves the elastic properties, the water resistance, carbonation resistance etc. of the water glass.

[0049] As dust binding agents, alcohols, polyols, film forming polymers, gelling polymers, waxes, oils, fats, paraffines etc. are appropriately used. The task of the dust binding agent is to bind together the dust or to bind it to the main

matrice either physically (film forming) or chemically (surface active properties). In case high temperature curing is used, melting dust binding agents, e.g. stearates, can be used, or curing dust binders, forming a film over the matrice. A great number of the dust binding agents simultaneously have a water repellent effect.

[0050] The task of the hydrophobizing agent is to prevent water and moisture from penetrating into the product. As hydrophobizing agents, silanes, silicones, oils, various hydrophobic compounds and hydrophobic starch are used. It is essential that possible hydrophilic emulgators are destroyable, which happens by raising the pH value or by a temperature raise.

[0051] The polybutene silane compound has proved especially advantageous as a dust binding agent and a hydrophobing agent. The polybutene acts as a dust binder and the silane as a hydrophobing agent.

[0052] Within the various groups, compatible compounds can be mixed in advance, whereas non compatible compounds have to be mixed immediately before the application or applied through separate nozzles.

[0053] The invention is explained below by means of various examples and indicating the values of various essential properties of the produced insulating products.

Example 1

[0054] A suspension of 83% of water glass (R_s = 2.7, dry content 39%) and 13% of blast furnace slag were mixed with a modifying solution (dry content 8%), containing silane as a hydrophobing agent and polybutene as a film forming dust binder, in a tubular mixer. Calculated as dry substance, the water glass forms 11.2% of the wool, the slag 13% of the water glass and the modifiers 1.8% of the water glass. The wool production was 2.8 tons/h and the dosing of the various solutions was 10.2 l/min of water glass-slag-suspension, 3.2 l/min of modyfier solution as well as water 10 l/min. The primary web was rolled into a tubular bowl having a diametre of 350 mm and a wall thickness of 60 mm and the tubular bowl was cured at 145°C for 3 min. A piece 63.5 x 63.5 mm was cut out from the tubular bowl and was tested with regard to linear shrinking at 600°C according to ASTM 356-60. The shrinking was only 1.4% when the density of the product was 101 kg/m^3.

Example 2

[0055] A suspension of 95% of water glass (R_s =3.3, dry content 37%) and 5% of blast furnace slag were mixed with an additional curing agent (5% H_3PO_4) and a modifier solution (dry content 5%), containing a hydrophobizing agent and a film forming polymer as a dust binder, in a tubular mixer. Calculated as dry substance, the water glass forms 11.4% of the wool, the slag 5%, the phosphoric acid 2.5% and the modifiers 0.8% of the water glass. The wool production was 3.2 tons/h and the dosing of the various solutions was 12.5 l/min of the water glass/slag-suspension, 5.3 l/min of the additional curer, 4.2 l/min of the modifier solution as well as water 11 l/min. Out of the primary web, a sheet web was prepared in a curing chamber at 140°C. Fire tests according to SFS 4193 were carried out on sheets having a thickness of only 26 mm and a density of 217 and 225 kg/m_3 respectively, yielding a fire resistance of 52 and 58 min. respectively. The temperature rise on the fire side according to SFS 4193 appears from fig. 1 and table 1. The test was continued for one hour and the temperature was 925°C at the end of the test. The sheet was totally undeformed and unbent and the burnt area still had a high residual strength.

[0056] It should be observed that the results given in the figures do not by any means indicate the upper limits, but only typical values that can be obtained. The results are collected from 11 different full-scale runs testing more than 70 different formulas.

[0057] Fig. 2 shows a typical relation between the splitting resistance and the density of a sheet product according to the invention.

[0058] Fig. 3 shows the relation between the tensile bending strength and the density of a number of sheet products according to the invention.

[0059] The force required for compressing a cured sheet product according to the invention 5 and 10% respectively is indicated in fig.4. The force is given as kN/m^2 as a function of the density.

[0060] Water absorption was tested according to BS2972:1975. The water absorption of sheet products aiming at a good hydrophobicity was:

After an immersion of 0.5 hours, only 0.3-1.6% by volume
After an immersion of 1 hour, only 0.6-2.4% by volume
After an immersion of 2 hours, only 1.1-3.0% by volume
After an immersion of 1 day only 3.8-7.0% by volume
After an immersion of 7 days only 9.1% by volume

The moisture resistance was tested in a climatic chamber by measuring the swelling during storage at 40°C and 95%

relative moisture. The temperature was selected as 40°C in order to obtain accelerated results, since swelling at 20-30 °C is practically none or very slow. The optimal results with a sheet product having a density of 140 kg/m^3 showed no swelling after 1 day and only a swelling of 0.3% after 7 days.

Table 1

Temperature rise as a function of time	
Time t min	Temperature rise of the furnace T-T° °C
5	556
10	659
15	718
30	821
60	925
90	986
120	1029
180	1090
240	1133
360	1193

Example 3

[0061] A suspension of 82% water glass (R_s = 2.4, dry matter content 44%) and 18% blast furnace slag were mixed with a modifier solution (dry content 10%), containing a hydrophobizing agent and a film forming polymer as a dust binding agent, in a tubular mixer. Calculated as a dry substance, the water glass represents 15.8% of the wool, the slag 50% of the water glass and the modifiers 3.6% of the water glass. The wool production was 2.8 tons/h and the dosing of the various solutions was 13.2 l/min of water glass/slag-suspension, 6.0 l/min of modifier solution and water 8 l/min. Out of the primary web, tubular bowls were prepared, having an outer diametre of 520 mm, a thickness of 120 mm and a density of 96.0 kg/m^3. The bowls were mounted on a steam pipe, whose temperature was raised up to 520°C. After 60 hours at this temperature the insulation was inspected and its λ value was determined.

[0062] The λ value was: 0.1010 W/m°C at 520°C. The bowls resisted the temperature (520°C) well. The only remarkable difference was that the inner surface of the bowl had become harder than the outer surface, probably due to the continued curing of the binder.

Claims

1. Insulating product intended in particular for the heat insulation of pipes, comprising a mineral fibre web equipped with binder, **characterized** in that said binder consists mainly of water glass and of slag, and the binder is present in the product in such an amount, that the weight ratio of the mineral fibre amount to the dry substance of the water glass is 100:1 - 100:20, preferably 100:5 - 100:15, and the slag is present in the binder in such an amount that the weight ratio of the dry substance of the water glass to the slag is 100:1 - 100:50, preferably 10:1 - 10:2.

2. Insulating product according to claim 1, **characterized** in that the slag is pulverised blast furnace slag.

3. Insulating product according to claim 1 or 2, **characterized** in that the binder contains modifying, dust binding, hydrophobizing and/or additional curing agents for the mineral fibres.

4. Insulating product according to claim 3, **characterized** in that the binder contains polybutene as a dust binding agent and silane as a hydrophobizing agent.

5. Insulating product according to any of the preceding claims, **characterized** in that it is uncured and packed in a moisture and gasproof package.

6. Method for making an insulating product out of a mineral fibre web equipped with a binder intended in particular for the heat insulation of pipes, the method comprising the steps of preparing the binder by mixing the binder components in water into a suspension, stirring the suspension, treating mineral fibres with the binder immediately after fibre formation and curing the binder immediately or at a desired time, at the prevailing outer temperature or at a raised temperature, **characterized** in that the binder consists mainly of water glass and of slag so that, in the product, the weight ratio of the mineral fibre amount to the dry substance of the water glass is 100:1 - 100:20, preferably 100:5 - 100:15, and the weight ratio of the dry substance of the water glass to the slag is 100:1 - 100:50, preferably 10:1 - 10:2.

7. Method according to the claim 6, **characterized** in that the molar ratio R_3 of the water glass is 2.3 - 3.0.

8. Method according to claim 6 or 7, **characterized** in that additives for further curing, modifying, dust binding and/or hydrophobing of the product are applied on the mineral fibre wool as a separate solution or mixed into the binder solution immediately before this is applied on the mineral fibre wool.

9. Method according to claim 8**, characterized** in that the additives are applied on the mineral fibre wool immediately after the fibre formation and/or later during the preparation.

10. Method according to any of claims 7-9, **characterized** in that the mineral fibre web equipped with a binder is cured at room temperature, e.g. between metal sheets, or at a raised temperature, e.g. in a curing chamber, after which the web is cut into the desired products, like insulating sheets.

11. Method according to any of claim 7-9, **characterized** in that the mineral fibre web equipped with a binder is shaped into products, like tubular bowls, which are cured in their moulds.

12. Method according to any of claim 7-9, **characterized** in that the mineral fibre web equipped with a binder is stored in an uncuring environment and that the curing is carried out at the desired time in situ, the product having been applied onto an insulation object.

Patentansprüche

1. Dämmprodukt, insbesondere zur Wärmedämmung von Rohren vorgesehen, umfassend ein mit einem Bindemittel versetztes Mineralfaservlies, **dadurch gekennzeichnet**, dass das Bindemittel vorwiegend aus Wasserglas und aus Schlacke besteht, und das Bindemittel im Produkt in einer solchen Menge vorhanden ist, dass das Gewichtsverhältnis der Mineralfasermenge zur Trockensubstanz des Wasserglases 100:1 - 100:20, bevorzugt 100:5 - 100:15 beträgt, und die Schlacke im Bindemittel in einer solchen Menge vorhanden ist, dass das Gewichtsverhältnis der Trockensubstanz des Wasserglases zur Schlacke 100:1 - 100:50, bevorzugt 10:1 - 10:2 beträgt.

2. Dämmprodukt nach Anspruch 1, **dadurch gekennzeichnet**, dass die Schlacke pulverisierte Hochofenschlacke ist.

3. Dämmprodukt nach Anspruch 1 oder 2, **dadurch gekennzeichnet**, dass das Bindemittel modifizierende, staubbindende, hydrophobierende und/oder zusätzliche härtende Mittel für die Mineralfasern enthält.

4. Dämmprodukt nach Anspruch 3, **dadurch gekennzeichnet**, dass das Bindemittel Polybuten als staubbindendes Mittel und Silan als hydrophobierendes Mittel enthält.

5. Dämmprodukt nach einem der vorhergehenden Ansprüche**, dadurch gekennzeichnet**, dass es ungehärtert ist und in eine feuchtigkeits- und gasundurchlässige Verpackung verpackt ist.

6. Verfahren zum Herstellen eines Dämmprodukts aus einem mit einem Bindemittel versetzten Mineralfaservlies, das insbesondere zur Wärmedämmung von Rohren vorgesehen ist, umfassend die Schritte, Herstellen des Bindemittels durch Mischen der Bindemittelkomponenten in Wasser in eine Suspension, Rühren der Suspension, Behandeln von Mineralfasern mit dem Bindemittel unmittelbar nach der Faserbildung und Härten des Bindemittels unmittelbar oder zu einem gewünschten Zeitpunkt, bei der vorherrschenden Aussentemperatur oder bei einer erhöhten Temperatur, **dadurch gekennzeichnet**, dass das Bindemittel vorwiegend aus Wasserglas und aus Schlacke besteht, so dass im Produkt das Gewichtsverhältnis der Mineralfasermenge zur Trockensubstanz des Wasserglases 100:1 - 100:20, bevorzugt 100:5 - 100:15 beträgt, und das Gewichtsverhältnis der Trockensubstanz des Wasserglases zur Schlacke 100:1 - 100:50, bevorzugt 10:1 - 10:2 begrägt.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet**, dass das Molverhältnis R_s des Wasserglases 2,3 - 3 beträgt.

8. Verfahren nach Anspruch 6 oder 7, **dadurch gekennzeichnet**, dass die Additive für weiteres Härten, Modifizieren, Staubbinden und/oder Hydrophobieren des Produkts als eine separate Lösung auf die Mineralfaserwolle aufgebracht werden oder der Bindemittellösung beigemischt werden, unmittelbar bevor diese auf die Minaralfaserwolle aufgbracht wird.

9. Verfahren nach Anspruch 8, **dadurch gekennzeichnet**, dass die Additive unmittelbar nach der Faserbildung und/oder später während der Herstellung auf die Mineralfaserwolle aufgebracht werden.

10. Verfahren nach einem der Ansprüche 7 - 9, **dadurch gekennzeichnet**, dass das mit einem Bindemittel versetzte Mineralfaservlies bei Raumtemperatur gehärtet wird, z.B. zwischen Metallplatten, oder bei einer erhöhten Temperatur, z.B. in einer Härtkammer, wonach das Vlies zu den gewünschsten Produkten, wie Dämmplatten, geschnitten wird.

11. Verfahren nach einem der Ansprüche 7 - 9, **dadurch gekennzeichnet**, dass das mit einem Bindemittel versetzte Mineralfaservlies in Produkte, wie röhrenförmige Teile geformt wird, die in ihren Formen gehärtet werden.

12. Verfahren nach einem der Ansprüche 7 - 9, **dadurch gekennzeichnet**, dass das mit einem Bindemittel versetzte Mineralfaservlies in einer nichthärtenden Umgebung gelagert wird und dass das Härten zu einem gewünschten Zeitpunkt in situ durchgeführt wird, wobei das Produkt auf ein zu dämmendes Objekt aufgebracht worden ist.

Revendications

1. Produit isolant, destiné en particulier à l'isolation thermique de conduites, comprenant une toile de fibres minérales et un liant, **caractérisé** en ce que ledit liant consiste principalement en un verre soluble et en un laitier, et que le liant est présent dans le produit dans une quantité telle que le rapport pondéral de la quantité de fibres minérales à la substance sèche du verre soluble est de 100:1 à 100:20, de préférence de 100:5 à 100:15, et que le laitier est présent dans le liant dans une quantité telle que le rapport pondéral de la substance sèche du verre soluble au laitier est de 100:1 à 100:50, de préférence de 10:1 à 10:2.

2. Produit isolant selon la revendication 1, **caractérisé** en ce que le laitier est du laitier de haut fourneau pulvérisé.

3. Produit isolant selon la revendication 1 ou 2, **caractérisé** en ce que le liant contient des agents modifiant, antipoussière, hydrophobisants et/ou des agents de durcissement supplémentaires pour les fibres minérales.

4. Produit isolant selon la revendication 3, **caractérisé** en ce que le liant contient du polybutène comme agent antipoussière et du silane comme agent hydrophobisant.

5. Produit isolant selon l'une quelconque des revendications précédentes, **caractérisé** en ce qu'il est non durci et conditionné dans un emballage étanche et à l'épreuve du gaz.

6. Procédé de préparation d'un produit isolant en utilisant une toile de fibres minérales, comprenant un liant, destiné en particulier à l'isolation thermique de conduites, le procédé comprenant les étapes de préparation d'un liant en mélangeant les composants de ce liant dans l'eau pour former une suspension, en agitant la suspension, en traitant les fibres minérales avec le liant immédiatement après la formation des fibres, et en durcissant le liant immédiatement ou au moment désiré, à la température régnant à l'extérieur ou à une température élevée, **caractérisé** en ce que le liant consiste principalement en un verre soluble et en un laitier, de telle manière que, dans le produit, le rapport pondéral de la quantité de fibres minerales à la substance sèche du verre soluble est de 100:1 à 100:20, de préférence de 100:5 à 100:15, et que le rapport pondéral de la substance sèche du verre soluble au laitier est de 100:1 à 100:50, de préférence de 10:1 à 10:2.

7. Procédé selon la revendication 6, **caractérisé** en ce que le rapport molaire R_s du verre soluble est de 2,3 à 3,0.

8. Procédé selon la revendication 6 ou 7, **caractérisé** en ce que les additifs pour le durcissement, la modification, le traitement antipoussière et/ou l'hydrophobisation ultérieurs du produit, sont appliqués sur la laine de fibres minérales sous forme d'une solution distincte, ou mélangés à la solution du liant immédiatement avant que celle-ci ne soit

appliquée sur la laine de fibres minérales.

9. Procédé selon la revendication 8, **caractérisé** en ce que les additifs sont appliqués sur la laine de fibres minérales immédiatement après la formation des fibres et/ou plus tard, pendant la préparation.

10. Procédé selon l'une quelconque des revendications 7 à 9, **caractérisé** en ce que la toile de fibres minérales comprenant un liant est durcie à température ambiante, entre des feuilles métalliques par exemple, ou à une température élevée dans une chambre de durcissement par exemple, à la suite de quoi la toile est découpée selon les produits désirés, en feuilles isolantes par exemple.

11. Procédé selon l'une quelconque des revendications 7 à 9, **caractérisé** en ce que la toile de fibres minérales comprenant un liant est formée en produits, en bols tubulaires par exemple, qui sont durcis dans leurs moules.

12. Procédé selon l'une quelconque des revendications 7 à 9, **caractérisé** en ce que la toile de fibres minérales comprenant un liant est stockée dans un environnement non durcissant et que ce durcissement est effectué au moment désiré in situ, le produit ayant été appliqué sur un objet isolant.

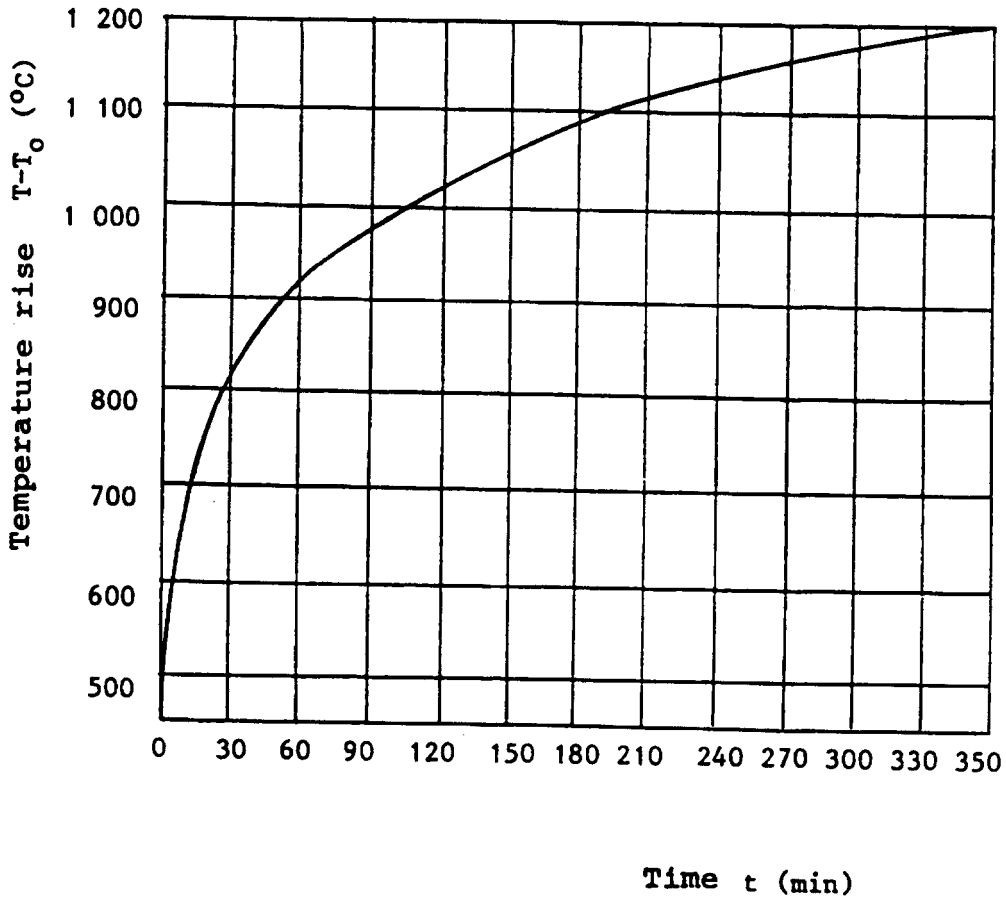
Temperature rise T-T$_o$ (°C)
1 200
1 100
1 000
900
800
700
600
500
0
30
60
90
120
150
180
210
240
270
300
330
350
Time t (min)

FIG. 1

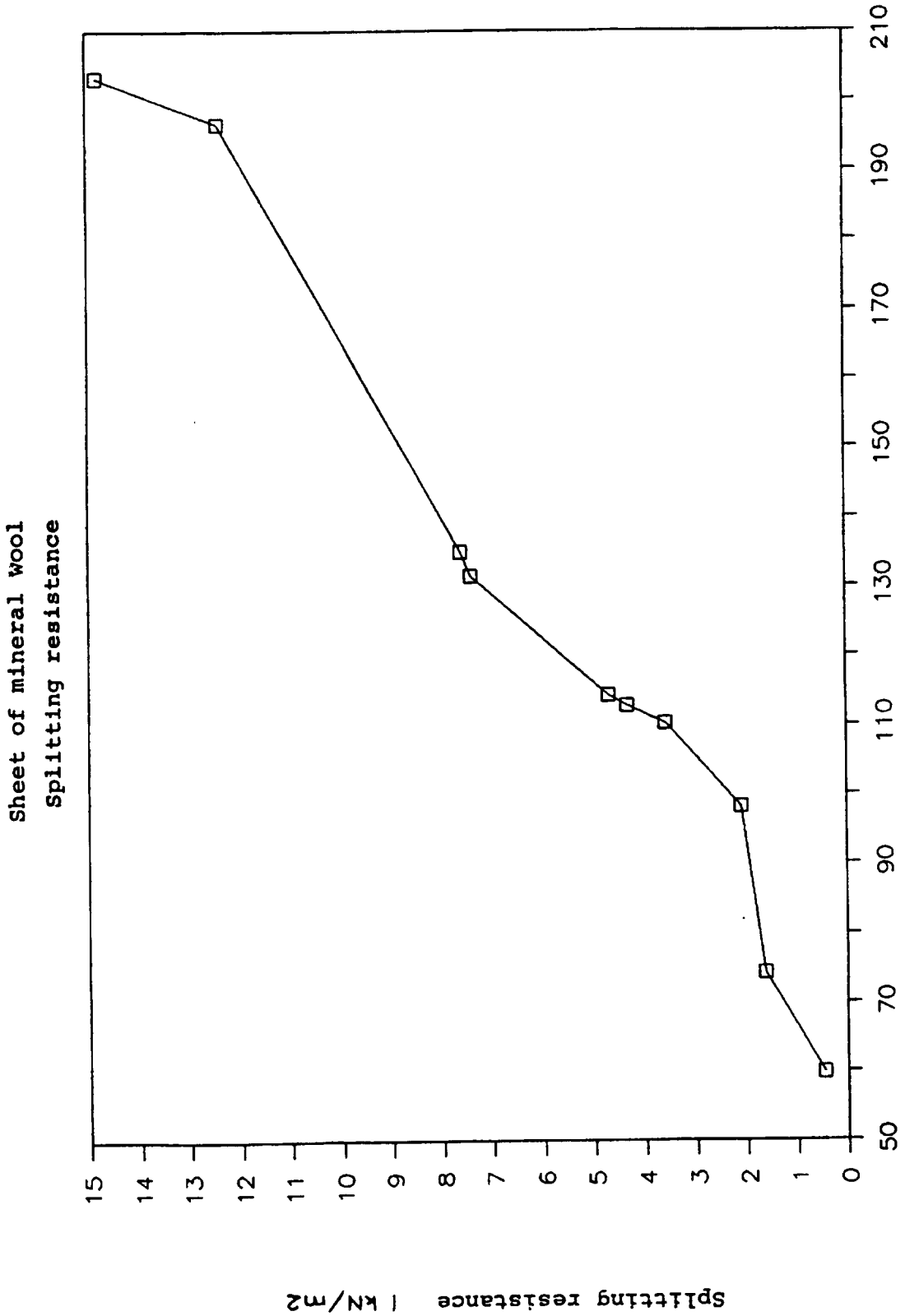
Sheet of mineral wool
Splitting resistance
Splitting resistance | kN/m2
Density | kg/m3
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
50
70
90
110
130
150
170
190
210

FIG. 2

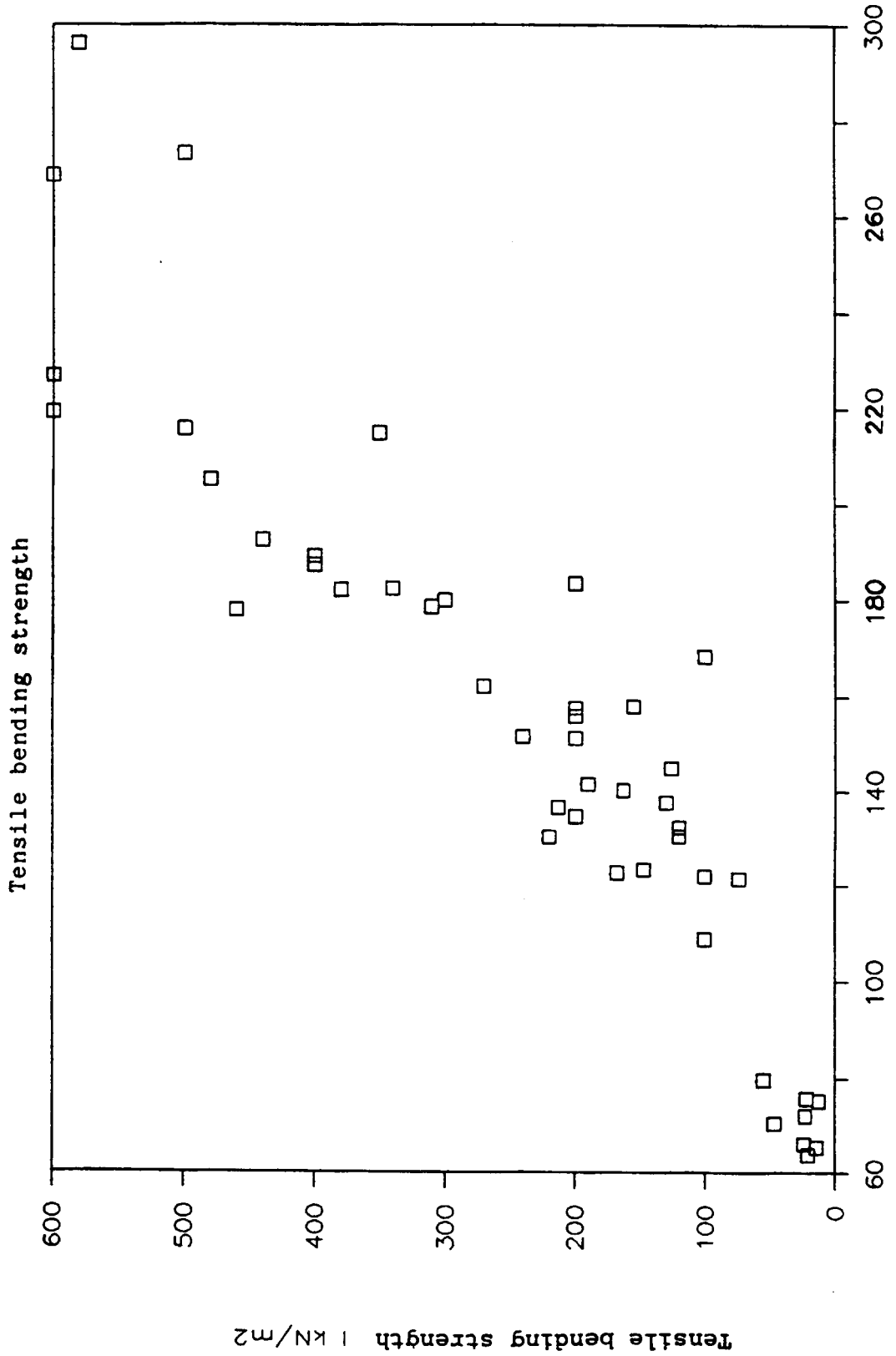
Tensile bending strength
600
500
400
300
200
100
0
60
100
140
180
220
260
300
Density | kg/m3
Tensile bending strength | kN/m2

FIG. 3

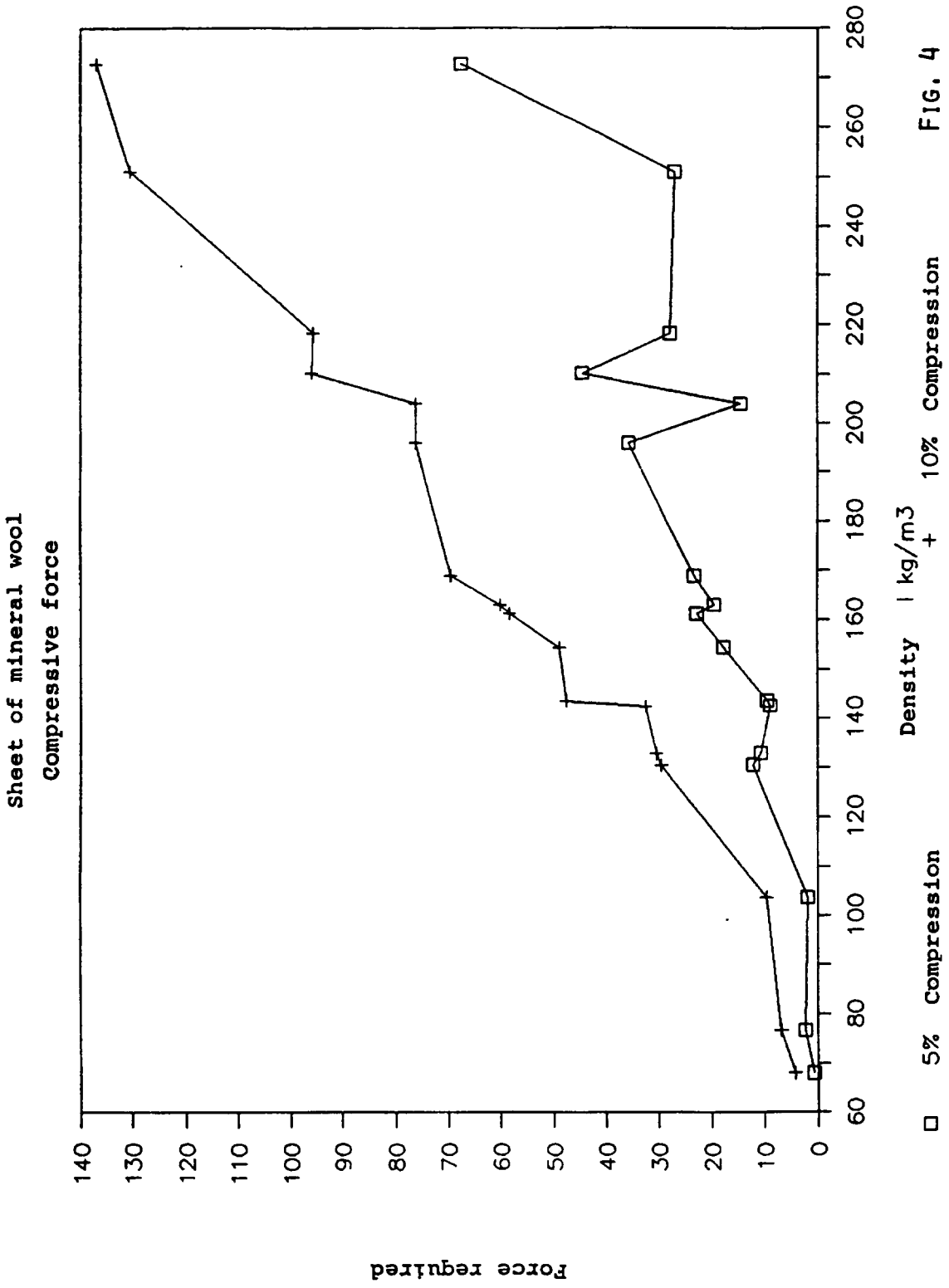
Sheet of mineral wool
Compressive force
Force required
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
60
80
100
120
140
160
180
200
220
240
260
280
Density | kg/m3
□ 5% Compression
+ 10% Compression

FIG. 4