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(54) Title: DISPERSION, SLURRY AND PROCESS FOR PRODUCING A CASTING MOULD FOR PRECISION CASTING
USING THE SLURRY

(57) Abstract: Slurry which contains a) from (50) to (80)% by weight of refractory particles having an average particle size of from (0.5) m to (150) m, b) from (5) to (35)% by weight of aluminium oxide particles having an average particle diameter of less than (300) nm and c) from (5) to (35)% by weight of water and d) a pH of from (5) to (12). Process for producing the slurry using a dispersion, and also the dispersion itself. Process for producing a casting mould, and also the casting mould itself.



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**Dispersion, slurry and process for producing a casting
mould for precision casting using the slurry**

The present invention relates to a dispersion, a slurry, a process for producing a casting mould for precision casting
5 and also a casting mould which can be obtained by this process.

One form of precision casting for metals is "investment casting", also known as the lost wax process. Here, a model of the workpiece to be produced later is firstly made from
10 wax or other materials which are easy to shape and melt, e.g. plastics or urea. The model is then provided with pouring or venting channels and subsequently encased in the moulded material. The model is melted out of the green mould formed here so as to produce a hollow mould which can
15 subsequently be fired if appropriate. Molten metal is then poured into this hollow space in the mould and solidified in the casting mould, so that the raw casting can be obtained after removal of the casting mould.

To obtain the casting, the casting mould is broken and the
20 raw casting subsequently undergoes finishing. This casting technique is used especially where the workpiece has to meet demanding requirements in terms of precision, large numbers of reproductions are required and complicated shapes are to be produced.

25 Production of the casting mould requires the positive of the casting modelled from wax or plastic, a slurry comprising a binder, refractory particles and, if appropriate, additives and also refractory particles for sanding, called "stucco", namely for coating the wax shape
30 which has been wetted with slurry.

Depending on the type of metal casting, the casting mould has to meet different requirements. Thus, ceramic casting moulds which are highly refractory and heat resistant are used for, in particular, the casting of superalloys or for
5 single crystal casting.

Various publications describe numerous casting mould compositions which are suitable for high-temperature investment casting processes. Thus, US 4,188,450 describes a refractory composition for a casting mould which consists
10 essentially of aluminium oxide and a binder based on silicon dioxide, with mullite being formed during a sintering step above 1400°C in the production of the casting mould. A disadvantage of such casting moulds is that silicon dioxide or mullite frequently reacts with the
15 alloy constituents and is thus ruled out for many shaping processes or requires complicated surface treatment of the casting.

US 4,247,333 describes a process for producing casting moulds, in which aluminium oxide is likewise used as
20 refractory powder and the binder based on silicon dioxide is removed during firing of the casting mould as a result of firing being carried out under reducing conditions. It is said that a casting mould consisting entirely of aluminium oxide can be produced in this way. A disadvantage
25 of this process is that it is costly and time-consuming.

DE 2909844 discloses a process for producing a casting mould, in which a fibrous colloidal alumina sol is used as a binder. A disadvantage of this process is the fact that the alumina sol displays only in a narrow pH range an
30 adequate stability against gelling. A mixture for producing casting moulds comprising refractory materials that display

a basic character and the acidic alumina sol causes an instability. The instability manifest itself for example in complete gelling of the mixture. In addition the instability does not result in an acceptable quality of the casting mould, e.g. in the form of inhomogeneity and cracks. If at all, these problems may be reduced by a continuous measurement of the pH and its correction by dosage of acid. Such a procedure is not feasible in practice.

10 It is therefore an object of the present invention to provide a slurry and a process for producing a casting mould for precision casting which do not have the disadvantages of the prior art.

A further object of the present invention is to provide a
15 dispersion for producing the slurry.

Another object of the present invention is to provide a casting mould produced by this process.

The invention provides a slurry which contains

- a) from 50 to 80% by weight, preferably from 60 to 75% by
20 weight, of refractory particles having an average particle size of from 0.5 μm to 150 μm , preferably from 5 to 40 μm ,
- b) from 5 to 35% by weight, preferably from 10 to 20% by weight, of aluminium oxide particles having an average
25 particle diameter of less than 300 nm, preferably from 10 to 200 nm and particularly preferably from 60 to 120 nm,
- c) from 5 to 35% by weight of water, preferably from 10 to 25% by weight, and has
- 30 d) a pH of from 5 to 12, preferably from 7.5 to 11.

The percentages by weight are based on the sum of the constituents a) to c). The slurry can additionally contain further constituents.

The slurry of the invention is a slurry which has an
5 extremely high stability with respect to viscosity increase, settling and gelling. The stability of the slurry is probably due in large parts to a combination of the features particle diameter and pH.

The BET surface area of the aluminium oxide particles
10 having an average particle diameter of less than 300 nm which are present in the slurry of the invention is not critical. In general, the BET surface area is from 20 to 200 m²/g, preferably from 50 to 120 m²/g. The particles can be present either as isolated individual particles or as
15 aggregated particles. Mixed forms are likewise possible.

As aluminium oxide particles having an average particle diameter of less than 300 nm, it is possible to use, for example, boehmites or pseudoboehmites. The best results when the slurry of the invention is used for producing
20 casting moulds are obtained with pyrogenic aluminium oxide particles. These are then predominantly or exclusively present in aggregated form. For the purposes of the present invention, aggregates are primary particles which are firmly grown onto one another. These aggregates can be
25 broken up only with difficulty or not at all by means of dispersing apparatuses. A plurality of aggregates can be loosely attached to one another to form agglomerates, and this phenomenon can be reversed by means of an appropriate dispersing process. The average aggregate diameter can be
30 determined by means of methods known to those skilled in the art, e.g. light scattering or counting of aggregates in

transmission electron micrographs.

For the purposes of the present invention, pyrogenic means that the particles have been obtained by means of flame hydrolysis or flame oxidation. Here, very finely divided, nonporous primary particles are formed first and these grow together to form aggregates during the further course of the reaction. The surfaces of these particles can have acidic or basic sites.

To increase the stability of the slurry of the invention further, a buffered pH has been found to be advantageous. A buffer which comprises one or more at least dibasic carboxylic acids and at least one salt of a di(alkali metal) hydrogenphosphate and/or alkali metal hydrogenphosphate is particularly suitable for this purpose. The proportion of the buffer constituents is preferably, in each case independently of one another, from $0.3 \text{ to } 3 \times 10^{-6} \text{ mol/m}^2$ of specific surface area of the aluminium oxide.

Furthermore, the slurry of the invention can contain up to 10% by weight, based on the total weight of the slurry, of one or more additives. These include antifoams, wetting agents, polymers, e.g. in form of dispersions, polyphosphates, metal-organic compounds and antibacterial agents. The proportion of antifoams, wetting agents, polyphosphates, metal-organic compounds and antibacterial agents can preferably be, in each case, from 0.01 to 5% by weight and particularly preferably from 0.1 to 1% by weight. The proportion of the polymer is preferably from 1 to 5% by weight.

In a particularly preferred embodiment, the slurry of the invention contains one or more polyphosphates. In the

context of the present mode of operation, it has been found that, in particular, the strength of the casting mould can be increased by addition of polyphosphates as additional additives. This effect is possibly attributable to the polyphosphates forming three-dimensional polymeric networks with the aluminium oxide particles having an average particle diameter of less than 300 nm during production of the casting mould. In a particularly advantageous embodiment of the present invention, the slurry contains from 0.05% by weight to 2.0% by weight of sodium tripolyphosphate.

Suitable polymers are neopren polymers, urethane polymers, acrylic latex polymers and styrene butadiene latex polymers.

The refractory particles having an average particle size of from 0.5 μm to 150 μm which are present in the slurry of the invention are preferably selected from the group consisting of aluminium oxide, zirconium oxide, mullite, andalusite, zirconium mullite, stabilized zirconium oxide, yttrium oxide, cobalt oxide, cobalt-aluminium spinel and rare earth oxides. Particular preference is given to α -aluminium oxide, for example in the form of fused alumina. Very particular preference is given to using white high-purity α -alumina having a content of aluminium oxide based on the ashing residue of greater than 99% or brown standard α -alumina having a content of aluminium oxide of greater than 95%. Furthermore, owing to its content of silicon dioxide based on the ashing residue of less than 0.1%, white high-purity α -alumina can be preferred over brown α -alumina for the casting of particular metals. Both fused alumina grades are characterized by the virtually complete absence of open porosity.

A particular advantage of the slurry of the invention is its stability with respect to viscosity, gelling, sedimentation and bacterial decomposition.

As a rule the slurry according to the invention displays a
5 stability of at least 12 hours, preferably at least 2 days.

The invention further provides a process for producing the slurry of the invention, in which an aqueous dispersion which contains

- 10 a1) aluminium oxide particles having an average particle diameter of less than 300 nm as solid and
- a2) has a content of aluminium oxide particles of more than 15% by weight, preferably from 25 to 70% by weight, particularly preferably from 35 to 60% by weight, and has
- 15 a3) a pH of from 5 to 12, preferably from 7.5 to 9, more preferably 7.5 to 8.5, is admixed with
- b) refractory particles having an average particle size of from 0.5 μm to 150 μm and
- c) if appropriate, additives.

20 Due to the high solids content of the alumina particles the process according to the invention allows a rapid drying of the slurry when producing a casting mould. In addition the process according to the invention allows a fast slurry make up using low shear conditions.

25 Thus a fast slurry make up can be achieved, as a rule within a period of maximal 12 hours, preferably of less than 5 hours. this is a considerable improvement over the state of the art, where at least 1 day is necessary for the slurry make up.

The aluminium oxide particles are preferably aggregated aluminium oxide particles and particularly preferably pyrogenic aluminium oxide particles. Furthermore, the dispersion used can be buffered. A buffer comprising one or
5 more at least dibasic carboxylic acids, for example citric acid or tartaric acid, and at least one salt of a di(alkali metal) hydrogenphosphate and/or alkali metal hydrogenphosphate, where the proportion of the buffer constituents is, in each case independently of one another,
10 from 0.3 to 3×10^{-6} mol/m² of specific surface area of aluminium oxide, can be used for this purpose.

The zeta potential of the dispersion used is preferably below -15 mV. Particular preference is given to a zeta potential in the range from -25 to -40 mV.
15 The zeta potential is a measure of the surface charge on the particles, which can be influenced by substances which become attached to the surface. For the purposes of the present invention, the zeta potential is the potential at the shear plane within the electrochemical aluminium oxide
20 particle/electrolyte double layer in the dispersion. The zeta potential can, for example, be determined by measuring the colloidal vibration current (CVI) of the dispersion or by determining the electrophoretic mobility.

Furthermore, it is possible to use one or more additives.
25 These encompass antifoams, wetting agents, polymers as mentioned before, binders, polyphosphates, metal-organic compounds, refractory fibres and antibacterial agents. Antifoams, wetting agents, polyphosphates, metal-organic compounds and antibacterial agents are preferably used in
30 proportions of from 0.01 to 5% by weight and particularly preferably in proportions of from 0.1 to 1% by weight, in each case based on the slurry. In a particularly preferred

embodiment, from 0.05 to 2% by weight of sodium tripolyphosphate are used. The polymer can preferably be used in a proportion of from 1 to 5% by weight, based on the slurry.

- 5 Suitable refractory fibres can be aramide fibres, carbon fibres, metal fibres, ceramic fibres, nitride fibres, carbide fibres, glass fibres, polymer fibres or cellulose fibres.

10 In a particular embodiment of the process, individual or all additives are constituents of the dispersion.

The invention further provides an aqueous dispersion of aluminium oxide particles, in which

- a) the aluminium oxide particles have an average particle diameter of less than 300 nm,
15 b) the content of aluminium oxide particles is more than 15% by weight, preferably from 25 to 70% by weight, particularly preferably from 35 to 60% by weight,
c) the dispersion additionally contains one or more additives selected from the group consisting of
20 antifoams, wetting agents, polymers, polyphosphates, metal-organic compounds and antibacterial agents and
d) the dispersion contains a buffer system and has a pH of from 5 to 12, preferably from 7.5 to 9, more preferably 7.5 to 8.5.

- 25 A suitable buffer system contains, for example, one or more at least dibasic carboxylic acids and at least one salt of a di(alkali metal) hydrogenphosphate and/or alkali metal hydrogenphosphate, where the proportion is, in each case independently of one another, from 0.3 to 3×10^{-6} mol/m² of
30 specific surface area of the aluminium oxide.

The zeta potential of the dispersion of the invention is preferably less than -15 mV. In a particularly preferred embodiment, the zeta potential is from -25 to -40 mV.

The dispersion according to the invention displays a
5 especially good compatibility with the polymers.

The invention further provides a process for producing a casting mould, in particular for precision casting, which comprises the steps

- 10 a) dipping of a preshaped meltable model into the slurry of the invention,
 - b) coating of the surface of the model which is covered with the slurry by sanding with coarse, refractory particles having an average particle size of from >50 μm to 1000 μm , preferably > 100 μm to 400 μm , and
 - 15 c) drying of the coated surface,
- where the steps a) to c) are repeated as often as desired until the number of coating layers required for the casting mould has been reached.

The coarse, refractory particles having an average particle
20 size of from > 50 μm to 1000 μm which are used for sanding the surface covered with the slurry are preferably likewise selected from the group consisting of aluminium oxide, zirconium oxide, mullite, andalusite, zirconium mullite, stabilized zirconium oxide, yttrium oxide and rare earth
25 oxides.

In a particularly preferred embodiment of the process of the invention, aluminium oxide particles are used both as refractory particles having an average particle size of from 5 μm to 40 μm and as coarse, refractory particles
30 having an average particle size of from > 100 μm to 200 μm .

In general, the process of the invention comprises a sintering step after the last drying step. This gives the casting mould obtained sufficient strength for its later use. However, it is also possible to carry out the process
5 without an additional sintering step and to strengthen the casting mould obtained "in situ" during precision casting.

The use of the slurry of the invention makes it possible to achieve very constant drying rates. This means that drying of the casting mould occurs very gently, so that the
10 casting mould does not suffer any damage.

The invention further provides a casting mould, in particular for precision casting, which can be obtained by this process.

The present invention encompasses three types of particles,
15 namely refractory particles having an average particle size of from 0.5 to 150 μm , coarse refractory particles having an average particle size of from >50 to 1000 μm and aluminium oxide particles having an average particle diameter of less than 300 nm.

20 The casting mould preferably comprises at least 98% by weight, based on the ashing residue, of aluminium oxide.

Furthermore, a casting mould which is essentially free of silicon dioxide can be advantageous. For the present purposes, this means that the proportion of silicon dioxide
25 is not more than 2% by weight, preferably not more than 0.5% by weight and particularly preferably not more than 0.1%.

Furthermore, a casting mould whose aluminium oxide particles having an average particle diameter of less than

300 nm are pyrogenic aluminium oxide particles can be advantageous.

The sintering temperatures required for a casting mould according to the invention which consists essentially of aluminium oxide, i.e. comprises at least 98% by weight of aluminium oxide, are usually about 900-1400°C, preferably about 1350°C, and mechanical properties of the casting mould which are comparable to those of a casting mould which has been conventionally produced on the basis of binders containing silicon dioxide can be achieved after a sintering time of about 3 hours. However the casting mould of the invention has the advantage over a conventional casting mould that it is largely chemically inert and can therefore be used for virtually all superalloys.

15 **Examples**

Production of dispersion 1:

Deionized water is placed in a 60 l stainless steel make-up vessel. Aluminium oxide powder (1) is subsequently sucked in under shear conditions by means of the suction tube of an Ystral Conti-TDS 3 (stator slits: 4 mm ring and 1 mm ring, rotor-stator spacing about 1 mm).

A buffer solution of anhydrous citric acid, disodium hydrogenphosphate dihydrate and water is then added and further aluminium oxide powder (2) is sucked in.

After the introduction is complete, the suction port is closed and the mixture is sheared at 3000 rpm for another 10 minutes. After milling is complete, a preservative is added.

This predispersion is passed twice through a Sugino Ultimaizer HJP-25050 high-energy mill at a pressure of 2500 bar and diamond nozzles having a diameter of 0.3 mm

and is in this way subjected to further intensive milling.

Table 1: Dispersion 1

Dispersion		1
Deionized water	kg	41.1
Al ₂ O ₃ powder		AEROXIDE® Alu C*
(1)	kg	5.8
(2)	kg	28.2
Buffer solution		
Citric acid	kg	1.70
Na ₂ HPO ₄ dihydrate	kg	1.42
Water	kg	6.70
Preservative		Acticide® MV**
	g	77
pH after 48 h		7.5
Solids content	% by weight	40
av. particle diameter	nm	86

*from Evonik Degussa GmbH; **from THOR

5

Production of the slurry

Slurry 2a: To produce the slurry, 3 kg from Example 1 are placed in a reaction vessel and a total of 7 kg of electrofused α -alumina (aluminium oxide white WRG,

10 Treibacher Schleifmittel) screened to from 0 to 325 mesh are added a little at a time. 0.075% by weight of a wetting agent based on alcohol alkoxide (TEGO SURTEN W 111, EVONIK Industries) and 0.02% by weight of an antifoam (Burst 100, REMET) are subsequently added.

15 The mixture obtained in this way is stirred at a low shear rate until the viscosity measured by means of a "Zahn4" flow cup has reached a value of from 18 to 23 seconds.

In this type of viscosity measurement, the liquid to be measured is introduced to a particular fill height into a
20 horizontally aligned viscosity cup which has an outflow

nozzle on its underside which is initially closed, for example by means of a glass plate, after introduction of the liquid. The time measurement commences as soon as the outflow nozzle is opened by removal of the glass plate. The
5 kinematic viscosity is measured in seconds over the time until the outflow stream breaks for the first time and can then be converted into Centistokes (cST). In such viscosity measurements, different types of cup can be used depending on the measurement range or measurement method. In the
10 present case, an ELCOMETER® 2210 Zahn flow cup having a nozzle size 4 was used. Stabilization of the viscosity was effected by targeted addition of dispersion, water or refractory particles.

The slurry produced in this way can be used in the
15 customary fashion for the production of casting moulds.

Slurry 2b: Analogous to slurry 2a but with addition of 0.1% by weight of sodium tripolyphosphate.

Slurry 2c: Analogous to slurry 2b but varied with 0.43% by weight of sodium tripolyphosphate.

20 Production of the casting mould

Casting mould 3a: To produce the casting mould, a wax model based on RW 161 (from REMET) which is provided with a handle and has the dimensions 50 mm × 80 mm × 3 mm is used and is, in a first coating step, dipped into the slurry
25 from Example 2a for 8 seconds, with the handle not being completely covered with slurry so as to make later melting-out of the wax possible. The model which has been coated in this way with slurry is allowed to drip for about 18 seconds and then exposed to a sand stream of coarse,
30 refractory particles of aluminium oxide ALODUR® ZWSK 90

(Treibacher Schleifmittel) falling from a height of about 30 cm until no more particles adhere to the surface. Subsequent drying is carried out for 12 hours at room temperature and an atmospheric humidity of 30-60%. The
5 model is then dipped into the slurry again and the slurry-coated model is sanded under the same conditions with somewhat coarser refractory particles (aluminium oxide ALODUR® ZWSK 60, Treibacher Schleifmittel). The subsequent drying at room temperature and at atmospheric humidity of
10 30-60% is shortened to 3 hours.

After this intermediate layer, two further support layers are applied using coarser refractory particles (aluminium oxide ALODUR® ZWSK 30, Treibacher Schleifmittel). The support layers are dried for 3 hours. The final layer is
15 subsequently applied by simple dipping of the model into the slurry without further sanding with coarse, refractory particles.

This gives a casting mould having a layer thickness of 3.7-4.2 mm whose wax core is melted out in an oven at
20 100°C.

Casting mould 3b: analogous to Example 3a but using slurry 2b.

Casting mould 3c: analogous to Example 3a but using slurry 2c.

Comparative example

Slurry (4ba) for the primary layer: To produce a slurry for the primary layer, 18% by weight of a commercially available finished binder are admixed with 82% by weight of zircon sand (ZrSiO_4) screened to 0-325 mesh. As binder, use is made of REMASOL® ABOND® (from REMET) which consists essentially of about 30% by weight of colloidal silica and about 70% by weight of water.

Slurry (4bb) for the intermediate and support layers: To produce the slurry, 18% by weight of a commercially available finished binder based on colloidal silica (REMASOL® SP-ULTRA 2408, from REMET) are admixed with 82% by weight of molochite (aluminium silicate) screened to 200 mesh. The binder comprises 34% by weight of colloidal silica and 66% by weight of water.

Casting mould 4a: In the two abovementioned cases, the amount of the coarse, refractory particles is firstly divided into portions and then added in portions, with the viscosity of the slurry 4ba for the primary coating being set to 18-24 seconds (measured by ELCOMETER® 2210 Zahn 4 flow cup) while the viscosity of the slurry 4bb for the intermediate and support layers was set to 8-10 seconds. The amount of liquid which evaporated during the setting of the viscosity is replaced by addition of water. The pH is 8-10.5.

The casting mould is produced in a manner analogous to the casting mould 3a, with an equivalent model being firstly dipped for 8 seconds into the slurry for the primary layer and subsequently, after being allowed to drip, sanded with zircon sand as refractory particles in a particle size of

100-200 μm . Molochite 30-80 mesh are used as coarse,
 refractory particles for the intermediate layer, while
 molochite 16-30 mesh is used for the two support layers.
 The final layer was formed using the slurry 4bb without
 5 additional sanding.

Here too, the layer thickness was 3.7-4.2 mm. The wax core
 is melted out at 100°C in an oven.

Sintered casting moulds: The casting moulds 3a, 3b, 3c and
 4a are dried and sintered at various temperatures to form
 10 the casting moulds 3aa, 3ba, 3ca and 4aa and then tested to
 determine their mechanical strength and also their gas
 permeability. The corresponding test results are summarized
 in Tables 2 and 3.

15 **Table 2: Cold Modulus Of Rupture (CMOR) of the casting
 moulds**

Casting mould	CMOR [N/mm ²]		
	120°C	1100°C	1350°C
3aa	2.3	0.8	4.7
3ba	4.5	3.4	10.1
3ca	10.0	7.8	19.2
4aa*	2.3	7.2	14.0

*Comparison

Table 3: Gas permeability of the casting moulds 3aa and 4aa

Temperature [°C]	Gas permeability [L/min]	
	3aa	4aa*
950	0.22	0.28
1000	0.23	0.29
1050	0.36	0.42
1100	0.55	0.50
1150	0.74	0.78

*Comparison

The strength is determined in a three-point bending test using test specimens which are dried at 120°C or sintered at 1100°C or 1350°C. The specimen containing 0.43% by weight of sodium tripolyphosphate displays the highest strength values of all specimens at all treatment temperatures.

It should, however, be remarked that the strength is not the only criterion for the suitability of a mould for precision casting. Although high strengths guarantee the durability of the mould during casting, which is an indispensable prerequisite for use of the casting mould, excessively high strengths at the same time make subsequent removal of the mould more difficult.

The comparative specimen 4aa, which has sufficient strength, can be used as a guide to the strength required for precision casting.

In summary, it can be stated that the process of the invention makes it possible, by means of targeted heat treatment and, if appropriate, addition of additives such as sodium tripolyphosphate, to obtain a casting mould which is sufficiently strong for precision casting and is virtually free of silicon dioxide.

Compared to the process disclosed in US 5,297,615, the present invention allows simpler production of a casting mould composed of aluminium oxide and having good strength values.

Compared to the slurry used in US 5,297,615, the slurry of the invention has a high stability.

From the results shown in Table 3, which are based on measurements carried out by a method based on British

Standard (BS 1902; Section 10.2; 1994), it can be seen that gas permeability values comparable to those of standard materials for casting moulds are also achieved.

Example 5: Drying rate

5 Table 4 shows the drying rate of a topcoat (i.e. first layer on the wax model) for the slurry 2b according to the invention and the comparative slurry 4ba. The drying rate describes the percentage decrease in weight of the moist layer at a temperature of 25°C and a relative atmospheric
10 humidity of 75%.

Table 4: Drying rate (in % by weight)

Time [min]	Slurry 4ab	Slurry 2b
5	100	100
15	98.1	99.3
25	97.1	98.5
35	96.5	97.8
50	96.2	97.2
65	96.0	96.9
95	95.8	96.3
125	95.7	95.9
155	95.6	95.7
185	95.5	95.6
215	95.4	95.5

It is clear from Table 4 that the decrease in weight of the layer of the slurry 4ba proceeds more quickly (i.e. at high drying rates) in the first 100 minutes but then
15 approximates that of the slurry 2b according to the invention. A very rapid drying rate in the first minutes is undesirable since this results in massive heat adsorption and shrinkage of the wax pattern and therefore damage the

casting mould. For this reason, it can be assumed that the drying of the layer of slurry 2b, which occurs with a significantly lower weight loss in the first minutes, is substantially more gentle and a casting mould which has
5 fewer defects is therefore obtained.

Claims

1. Slurry, characterized in that it contains
 - a) from 50 to 80% by weight, of refractory particles having an average particle size of from 0.5 μm to 150 μm ,
 - b) from 5 to 35% by weight, of aluminium oxide particles having an average particle diameter of less than 300 nm,
 - c) from 5 to 35% by weight of water and has
 - d) a pH of from 5 to 12.
2. Slurry according to Claim 1, characterized in that the aluminium oxide particles are aggregated.
3. Slurry according to Claim 1 or 2, characterized in that the aluminium oxide particles are pyrogenic aluminium oxide particles.
4. Slurry according to any of Claims 1 to 3, characterized in that it is buffered.
5. Slurry according to any of Claims 1 to 4, characterized in that it additionally contains not more than 10% by weight, based on the total weight of the slurry, of additional additives selected from the group consisting of antifoams, wetting agents, polymers, polyphosphates, metal-organic compounds and antibacterial agents.
6. Slurry according to any of Claims 1 to 5, characterized in that the refractory particles having an average particle size of from 0.5 μm to 150 μm are selected from the group consisting of aluminium oxide, zirconium oxide, mullite, andalusite, zirconium mullite, stabilized zirconium oxide, yttrium oxide, cobalt-

aluminium spinel, cobalt oxide and rare earth oxides.

7. Process for producing the slurry according to any of Claims 1 to 6, characterized in that an aqueous dispersion which contains
 - 5 a1) aluminium oxide particles having an average particle diameter of less than 300 nm as solid and
 - a2) has a content of aluminium oxide particles of more than 15% by weight and has
 - a3) a pH of from 5 to 12, is admixed with
 - 10 b) refractory particles having an average particle size of from 0.5 μm to 150 μm and
 - c) if appropriate, additives.
8. Aqueous dispersion of aluminium oxide particles, characterized in that
 - 15 a) the aluminium oxide particles have an average particle diameter of less than 300 nm,
 - b) the content of aluminium oxide particles is more than 15% by weight,
 - c) the dispersion additionally contains one or more
 - 20 additives selected from the group consisting of antifoams, wetting agents, polymers, polyphosphates, metal-organic compounds and antibacterial agents and
 - d) the dispersion contains a buffer system and has a
 - 25 pH of from 5 to 12.
9. Aqueous dispersion according to Claim 8, characterized in that it contains from 0.05 to 2.0% by weight of sodium tripolyphosphate, based on the dispersion.
10. Process for producing a casting mould, which comprises
 - 30 the steps

- a) dipping of a preshaped meltable model into the slurry according to any of Claims 1 to 6,
b) coating of the surface of the model which is covered with the slurry by sanding with coarse,
5 refractory particles having an average particle size of from $> 50 \mu\text{m}$ to $1000 \mu\text{m}$ and
c) drying of the coated surface,
where the steps a) to c) are repeated as often as desired until the number of coating layers required for
10 the casting mould has been reached.
11. Process according to Claim 10, characterized in that the coarse, refractory particles having an average particle size of from $> 50 \mu\text{m}$ to $1000 \mu\text{m}$ are selected from the group consisting of aluminium oxide, zirconium
15 oxide, mullite, andalusite, zirconium mullite, stabilized zirconium oxide, yttrium oxide, cobalt-aluminium spinel, cobalt oxide and/or rare earth oxides.
12. Casting mould produced by a process according to Claim
20 10 or 11.
13. Casting mould according to Claim 12, characterized in that it comprises more than 98% by weight of aluminium oxide.
14. Casting mould according to Claim 12 or 13,
25 characterized in that it is essentially free of silicon dioxide.
15. Casting mould according to any of Claims 12 to 14, characterized in that aluminium oxide particles having an average particle diameter of less than 300 nm are of
30 pyrogenic origin.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/054184

A. CLASSIFICATION OF SUBJECT MATTER

INV. B22C9/02 B22C9/22 B22C9/24 B22C13/08 B22C1/08
ADD.

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)

B22C

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)

EP0-Internal, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search

16 July 2010

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/054184

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2010/054184

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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International application No

PCT/EP2010/054184

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