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(54) Title: HIGH-ALUMINA RAW MATERIAL AND PROCESS OF PRODUCING

Al ₂ O ₃	50 - 80	%
MgO	2 - 15	%
SiO ₂	1 - 15	%
CaO	0.5 - 20	%
Fe ₂ O ₃	0.5 - 2	%
Na ₂ O	0.5 - 2	%
Al (metallic)	0.1 - 2	%
AlN	0.1 - 1	%
K ₂ O	0.1 - 1.5	%
F	0.1 - 2	%
Cl	0.1 - 0.8	%
balance in total maximum	5	%
loss on ignition maximum	15	%
and of the mineral main constituents		
aluminium hydroxides	20 - 60	%
corundum α-Al ₂ O ₃	10 - 40	%
spinel MgAl ₂ O ₄	5 - 40	%

(57) Abrégé/Abstract:

A high alumina raw material and method of producing such raw material are disclosed. The high alumina raw material consists of (on dried basis, in weight-%) (see above Table) wherein the aluminium hydroxides in the form of aluminium mono-hydroxide Al₂O₃.H₂O und aluminium tri-hydroxide Al₂O₃.3H₂O have a weight ratio of more than 0.25.

ABSTRACT

A high alumina raw material and method of producing such raw material are disclosed. The high alumina raw material consists of

(on dried basis, in weight-%)

Al ₂ O ₃	50 - 80	%
MgO	2 - 15	%
SiO ₂	1 - 15	%
CaO	0.5 - 20	%
Fe ₂ O ₃	0.5 - 2	%
Na ₂ O	0.5 - 2	%
Al (metallic)	0.1 - 2	%
AlN	0.1 - 1	%
K ₂ O	0.1 - 1.5	%
F	0.1 - 2	%
Cl	0.1 - 0.8	%
balance in total maximum	5	%
loss on ignition maximum	15	%
and of the mineral main constituents		
aluminium hydroxides	20 - 60	%
corundum α -Al ₂ O ₃	10 - 40	%
spinel MgAl ₂ O ₄	5 - 40	%

wherein the aluminium hydroxides in the form of aluminium mono-hydroxide

Al₂O₃.H₂O und aluminium tri-hydroxide Al₂O₃.3H₂O have a weight ratio of more than 0.25.

High-Alumina Raw Material and Process of Producing

Background of the Invention

The invention relates to a high-alumina raw material with 50-80 % Al_2O_3 , wherein Al_2O_3 is mineralogically in the form of corundum $\alpha\text{-Al}_2\text{O}_3$, spinel MgAl_2O_4 , aluminium mono-hydroxide $\text{Al}_2\text{O}_3\cdot\text{H}_2\text{O}$ and aluminium tri-hydroxide $\text{Al}_2\text{O}_3\cdot 3\text{H}_2\text{O}$, and the weight ratio of aluminium mono-hydroxide to aluminium tri-hydroxide is more than 0.25. Moreover the invention relates to a process of producing the high-alumina raw material starting from an alumina product extracted by treating aluminium salt slags, as well as the use as a sinter active alumina source for producing ceramic and refractory materials, cement, porosified binding agent building materials, slag formers for iron and steel, mineral wool and ceramic fibres.

High-alumina raw materials with an alumina content of 50-80 % are available either as natural raw materials (like bauxite, sillimanite, kyanite and andalusite) or are synthetically produced by chemical transforming of bauxite to pure alumina followed by sintering or fusion (like mullite and spinel). In order to save the natural resources the intention is more and more to use secondary raw materials recovered from waste materials of recycling processes.

Aluminium salt slag is generated as waste from recycling aluminium metal. In this process the surface of the fused metal is covered by a layer of salt (for example a mixture of 70 % NaCl , 28 % KCl and 2 % CaF_2) to prevent the oxidation of the metals as low as possible and to pick up oxidic impurities in the form a salt slag. The salt slag contains about 40-50 % salt, 40-50 % oxides and 10 % metallic

aluminium. As aluminium during melting in air does not only combine with oxygen but also with nitrogen, a salt slag besides alumina contains aluminium nitride as well.

In order to recover the components as complete as possible, the salt slag is subject of a treating process where after crushing the salt slag the metal can be mechanically recovered to a high degree. Afterwards the salt slag is treated with water and the salt is solved. By separating the unsoluble components, here called “alumina product”, the salt is crystallized by vaporisation of the solution and by this way can be used as melting salt again.

The alumina product contains about 50-80 % Al_2O_3 . M. Beckmann (Aluminium 67 [1991] 586-593) describes the Al_2O_3 to be mineralogically present in the form of corundum $\alpha\text{-Al}_2\text{O}_3$, spinel MgAl_2O_4 and aluminium tri-hydroxide $\beta\text{-Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ (bayerite). Aluminium tri-hydroxide is formed in the wet treatment of salt slag by the reaction of water with aluminium or aluminium nitride according to the following equations:



As in practise the degree of crushing the salt slag and the time of reaction are adjusted from the economical optimum points of view, the remaining contents of aluminium metal and aluminium nitride in the alumina product can achieve up to 5 %.

The alumina product is coming out of the wet treating process as a muddy filter cake (mostly with a humidity of about 30–45 % water, with a bad consistency for transport and dosage and a strong smell of ammonia. The unfavourable consistency and the remaining contents of aluminium metal and aluminium nitride are a considerable disadvantage in using the alumina product, especially for producing sintered or fused materials. During the further processing of the alumina product (mixing with other mineral materials, drying, calcining, sintering, fusion) are resulting the following partly serious problems:

- Bothering by ammonia during handling
- Strong thermal reaction and release of gas (water vapour, hydrogen, ammonia) during mixing with lime and cement, because of this poor mechanical strength of formed bodies (for example pellets and briquettes)
- Corrosion of equipment caused by release of gas
- Risk of explosion caused by release of gas
- Forming of mechanical stickings and obstructions in the mechanical equipment and transport ways
- Difficult to control local variations of temperatures overheating in rotary kiln sintering respectively caused by uncontrolled thermals reactions of the aluminium metal and the aluminium nitride, therefore unwanted forming of melt, stickings and lumpings.

From DE-4319163 there is known a fine grained filler for cement bonded solid materials, being a high alumina waste (alumina product) from the processing of salt slags of the aluminium industry, and that – on dried basis – has 55-70 % Al_2O_3 , 7-

10 % MgO, 6-9 % SiO₂ and a loss on ignition of 7-11 %. There is no information on a content of aluminium hydroxide.

DE-4345368 describes a process for producing sintered spinel containing aluminate cement clinker based on the same waste material as in DE-4319163, at sintering temperatures above 1100°C.

EP-0838443 covers a process for use of aluminium containing wastes by producing sintered sulfoaluminate cement, starting from for example a residue of the treatment of aluminium salt slags, containing 65.7 % Al₂O₃, 10.1 % MgO, 7.9 % SiO₂ and 7.3 % H₂O, and that has Al₂O₃ in the crystalline phases of corundum α -Al₂O₃, bayerite Al(OH)₃ and spinel MgAl₂O₄. The sintering temperatures are in the range of 1150-1300°C (examples 1 and 2).

EP-0881200 describes a refractory bottom lining for aluminium electrolytic cells in the form of a monolithic ramming mix of dried and calcined formed bodies (pellets, briquettes, bricks) on basis of a high alumina powder from the treatment of dross and salt slags from the aluminium industry, containing 40-90 % Al₂O₃, 4-20 % MgO, 0.5-15 % SiO₂, 0.1-25% AlN, 0.1-10% Al (metallic) and in maximum 10 % loss on ignition. The powder contains as crystalline phases corundum α -Al₂O₃, spinel MgOxAl₂O₃ and fluorspar CaF₂. Aluminium hydroxide is not mentioned.

EP-1036044 protects a process for producing synthetic glass fibres (rock wool, mineral wool), wherein 2-20 weight-% of the mineral solids are mineral waste with an content of halogens of at least 1 weight-%, like alumina residues from treatment

of aluminium dross and aluminium salt slag, with contents of 0.5-10 weight-% aluminium metal, 50-90 weight-% Al_2O_3 and up to 5 weight-% Fluor or other halogens. The letters patent contains no information on contents of aluminium hydroxide.

EP-1180504 concerns a porosifying, accelerating additive for binding agent building materials in form of a high alumina powder, containing 50-90 % Al_2O_3 , up to 10 % Al (metallic) and mineral main constituents in the form of corundum ($\alpha\text{-Al}_2\text{O}_3$) and spinel ($\text{MgO}\cdot\text{Al}_2\text{O}_3$), wherein the metallic aluminium particles are enveloped by mineral transition modifications of aluminium tri-hydroxide ($\text{Al}_2\text{O}_3\cdot 3\text{H}_2\text{O}$) to α -alumina. As it appears from the process of producing the powder, a high-alumina waste from the treatment of aluminium salt slag is shock dried at flue gas temperatures from 400 to 500°C and after that partially calcined at temperatures up to 1000°C. According to C. Misra (Industrial Alumina Chemicals, American Chemical Society 1986, page 76) there results at a rapid thermal dehydration of aluminium tri-hydroxides no transformation to aluminium mono-hydroxide, but a direct transformation to the transition modifications $\rho\text{-Al}_2\text{O}_3$, $\eta\text{-Al}_2\text{O}_3$ (above 400°C) and $\theta\text{-Al}_2\text{O}_3$ (above 750°C). Corundum $\alpha\text{-Al}_2\text{O}_3$ is formed above 1200°C.

US-5045506 contains the use of alumina products from the processing of aluminium dross and salt slag in the production of mineral wool, wherein (claim 6) the alumina product from the processing of salt slag must be heated (calcined) so high, that the existing aluminium hydroxide is transformed to aluminium oxide.

US-5424260 describes an alumina product NMP from the processing of aluminium salt slag and its use for the production of ceramic fibres. The alumina product NMP contains 40-75 weight-% Al_2O_3 , 5-20 weight-% MgO , 2-15 weight-% SiO_2 with a loss on ignition of about 20 weight-% (column 5, line 57-68). There is no information on contents of aluminium hydroxide.

US-6238633 claims a process for producing a sintered calcium aluminate slag former for the steel production, based on a non metallic product NMP (column 5, line 44 ff), consisting of 40-75 weight-% Al_2O_3 , 0-20 weight-% MgO , 2-15 weight-% SiO_2 , in each case less than 1 % aluminium metal and aluminium nitride and a loss on ignition at 1400°C of 5-35 weight-%. There is given no clear information on contents of aluminium hydroxides, except an "amorphous alumina precursor phase" respectively "hydrated amorphous phase", that transforms in corundum during calcining (column 6, line 39-48). After mixing with CaO or CaO -sources (calcium hydroxide oder calcium carbonate) pellets oder extrudates are formed and heated to a temperature between 1093 and 1193°C . A calcium aluminate produced by this way has a melting point of 1360°C (column 12, line 6-8). The NMP is produced from aluminium salt slag, wherein a reduction of the contents of aluminium metal and aluminium nitride by fine classification helps to avoid stickings and agglomerates during the sintering of the calcium aluminate (column 11, line 46-49). The disadvantage of this process is, that the mechanical separated aluminium metal and aluminium nitride are not available anymore for the formation of aluminium oxide, therefore the content of Al_2O_3 of the alumina source is reduced, in total a higher quantitiy of the alumina source is needed in the mixture and

caused by the included impurities in the NMP the purity and the quality of the calcium aluminate are made worse.

Summary of the Invention

It is an object of the invention to produce a high alumina raw material for products generated by sintering or fusion (ceramic and refractory materials, cement, porosified binding agent building materials, slag formers for iron and steel, mineral wool and ceramic fibres) based on the alumina product from the processing of salt slags of the aluminium industry. This alumina product is reduced in its direct usability caused by high residual contents of aluminium metal, aluminium nitride, ammonia and humidity. Especially the high alumina raw material should have better sintering properties. In Addition a fast setting building material with high porosity should be producible without necessary partial calcination of the alumina product in the temperature range of 400-1000°C (according to EP-1180504).

In accordance with the invention, the object is achieved by mechanically densifying an alumina product from the processing of aluminium salt slags (with contents of aluminium tri-hydroxide, aluminium metal and aluminium nitride) so sufficient that the progress of the exothermal reaction of residual aluminium metal and aluminium nitride with the humidity water to further aluminium hydroxide is favoured, and caused by the released heat humid warm hydrothermal conditions are generated, wherein the aluminium tri-hydroxide (bayerite) can transform into the aluminium mono-hydroxide (boehmite) with less crystal water. Starting from a wet alumina product residual aluminium metal and aluminium nitride can be transformed in

aluminium hydroxide without reduction of the total content of Al_2O_3 (in contrast with US-6238633). The smell of ammonia is reduced as well, caused by the vaporisation of the ammonia containing humidity water.

In accordance with an aspect of the present invention, there is provided a high-alumina raw material, consisting of

(on dried basis, in weight-%)

Al_2O_3	50 - 80	%
MgO	2 - 15	%
SiO_2	1 - 15	%
CaO	0.5 - 20	%
Fe_2O_3	0.5 - 2	%
Na_2O	0.5 - 2	%
Al (metallic)	0.1 - 2	%
AlN	0.1 - 1	%
K_2O	0.1 - 1.5	%
F	0.1 - 2	%
Cl	0.1 - 0.8	%
balance in total maximum	5	%
loss on ignition maximum	15	%
and of the mineral main constituents		
aluminium hydroxides	20 - 60	%
corundum $\alpha\text{-Al}_2\text{O}_3$	10 - 40	%
spinel MgAl_2O_4	5 - 40	%

wherein the aluminium hydroxides in the form of aluminium mono-hydroxide $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ and aluminium tri-hydroxide $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ have a weight ratio of more than 0.25.

The advantages of the aluminium mono-hydroxide boehmite compared with the aluminium tri-hydroxide bayerite during sintering or fusion are the lower content of crystal water, the wider range of temperature for the decomposition of the crystal water and the higher crystal density.

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In order to have a significant effect of the advantages of the content of boehmite the aluminium mono-hydrate should form at least 20 % of the aluminium hydroxide phases, therefore the ratio of boehmite to bayerite should be greater than 20:80 = 0.25. The ratio of the phases is determined by x-ray diffraction and comparison of the intensities of the peaks of boehmite ($d = 6,11 \text{ \AA}$) and bayerite ($d = 4,72 \text{ \AA}$). If boehmite is very fine crystalline or colloidal, a broadening of the peaks is detectable in the range of $d = 6,11 \text{ \AA}$.

The following table compares the properties of both aluminium hydroxide phases:

		Al-tri-hydroxide	Al-mono-hydroxide
Formula		$\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ or $\text{Al}(\text{OH})_3$	$\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ or AlOOH
Mineral phase		bayerite	boehmite
Al_2O_3	%	65,4	85,0
Loss on ignition (crystal water)	%	34,6	15,0
Decomposition of crystal water	$^{\circ}\text{C}$	200-400	400-700
Theoretical density	g/cm^3	2,53	3,01
Bulk density (without crystal water)	g/cm^3	1,65	2,56

According to C. Misra (Industrial Alumina Chemicals, American Chemical Society 1986, page 17) the hydrothermal transformation from aluminium tri-hydroxide into boehmite needs temperatures above 150°C. For adjusting the hydrothermal properties a closed heated pressure container (autoclave) is required as a rule.

The high-alumina raw material can be formed by - after drying the alumina product to a remaining humidity of less than 5 % - compacting and grinding in a vibration mill. A powder formed in such way is very suitable for producing porosified binding agent building materials (for example mineral foam based on alkaline water glass).

The high-alumina raw material can further be formed by compacting the alumina product in mixture with other suitable mineral materials, also having a particle size of at least 90 weight-% less than 500 µm. These mineral materials can for example be burnt lime, calcium hydroxide, cement (portland cement, aluminat cement), milled lime stone, sources of iron oxide and silicon oxide (clay, sand, burnt iron sulfide, haematite, red mud, fly ash). By this way mixtures can be formed, that can be used for producing ceramic and refractory materials, cement, porosified binding agent building materials, slag formers for iron and steel, mineral wool and ceramic fibres.

COMPARATIVE EXAMPLE 1**(STATE OF THE ART)**

In the following examples an alumina product was used, with muddy consistency, significant smell of ammonia, a humidity of 35 weight-%, a particle size of 90 weight-% less than 0.5 mm, the chemical composition of
(based of dried material, in weight.-%)

Al ₂ O ₃	61
Al-metal	2.4
AlN	1.1
SiO ₂	7.0
MgO	7.7
CaO	3.1
Fe ₂ O ₃	1.4
F	1.5
Cl	0.3
Loss on ignition at 600°C	11.6
Balance in total	2,9
and the mineral main constituents	
bayerite Al ₂ O ₃ ·3H ₂ O	33,5
spinel MgAl ₂ O ₄	27,5.
corundum α-Al ₂ O ₃	19,3.

The contents of the mineral main constituents were calculated from the chemical composition as follows:

bayerite = loss on ignition 600°C x 100 / 34,6 (crystal water of bayerite:
34,6 %)

spinel = MgO x 100 / 28 (MgO of spinell: 28 %)

corundum = (Al₂O₃ + MgO + loss on ignition 600°C) - bayerite - spinel

The product has a theoretical density of 2,95 g/cm³ and a bulk density of 1,65 g/cm³
(based on dried material: 1,07 g/cm³).

EXAMPLE 2

The alumina product according to example 1 was mixed with 10 weight-% CaO (burnt lime) in a high intensity mixer and by this way compacted as well. In the mixed material humid warm to hydrothermal conditions were generated, recognizable by the release of water vapour. After about 10 minutes the temperature in the mixture increased to more than 70°C. After 60 minutes the new high-alumina raw material had no more noticeable smell of ammonia, a humidity of 10 %, a content of 0.5 % aluminium metal and 0.3 % aluminium nitride. The ratio of therefore the ratio of boehmite to bayerite should be greater than $20:80 = 0.25$. The ratio of aluminium mono-hydroxide to aluminium tri-hydroxide determined by x-ray diffraction and comparison of the intensities of the peaks of boehmite ($d = 6,11 \text{ \AA}$) and bayerite ($d = 4,72 \text{ \AA}$) was 0.6.

From this example and further investigations can be derived that the degree of forming boehmite can be controlled depending on the compaction density, the size of the stock, the time of the treatment, the temperature of the environment and the exothermal reactivity of the mixing component with the humidity water. While for example CaO reacts strongly exotherm to calcium hydroxide, the reaction by addition of cement (portland cement, aluminat cement) will be weak. Dry additives with only physical binding of the humidity water by wetting of the surface of the particles, for example dry calcium hydroxide, lime stone powder,

iron oxide sources (like burnt iron sulfide, haematite, red mud) and silicon oxide sources (like clay, sand, fly ash) will at least contribute to improve the consistency of the alumina product.

EXAMPLE 3

For producing sintered calcium aluminate (as slag former for the steel production), with the main components CaO (about 40 weight-%) and Al₂O₃ (about 45 weight-%) the alumina product according to example 1 and high-alumina raw material according to example 2 respectively an lime stone powder with the composition (in weight-%)

CaO	54.2
CO ₂	43.1
SiO ₂	1.2
Al ₂ O ₃	0.5
Fe ₂ O ₃	0.4

in the corresponding ratios were mixed and formed to pellets of about 10 mm in diameter. The pellets were sintered in an electrically heated laboratory muffle kiln at 900 - 1300°C with a holding time of 30 minutes.

In relation to the sintering temperature the content of the mineral phase 12CaO.7Al₂O₃ (determined by X-ray diffraction, in weight-%) was:

Temperature °C	900	1000	1100	1200
Alumina product (example 1)	27	31	34	40
High-alumina raw material (example 2)	41	44	48	48

The formation of calcium aluminate $12\text{CaO} \cdot 7\text{Al}_2\text{O}_3$ therefore already was finished at 1100°C by using the high-alumina raw material according to example 2, while with the alumina product according to example 1 the reaction was still incomplete at 1200°C .

A slag former should have a melting point as low as possible. The melting point of the calcium aluminate, being sintered by use of the high-alumina raw material according to example 2 at 1100°C was only 1290°C (measured according to DIN 51070 by means of a heating microscope as temperature of the hemisphere body), while for the calcium aluminate slag former according to US-6238633 sintered at $1093\text{-}1193^\circ\text{C}$ the melting point of 1360°C is given as information.

From the better reactivity of the high-alumina raw material according to example 2 in the production of sintered calcium aluminate can be related, that this raw material also will have better sintering properties in other sintered products (like ceramics and refractories) or fused products (mineral wool, ceramic fibres) than the alumina product according to example 1 or US- 6238633.

EXAMPLE 4

For the production of a porosified building material an alumina product according to example 1 with 2.4 % aluminium metal at first was dried to a humidity of 4 weight-% and after that a quantity of 30 g in a vibration mill (laboratory disc mill) ground for a time of 10 minutes. The temperature of the content of the mill was kept at 85°C .

The so produced new raw material had a content of aluminium mono-hydroxide (boehmite) and aluminium tri-hydroxide (bayerite) in the weight-ratio of 1.9. The content of aluminium metal was 1.4 weight-%.

The new raw material was filled together with alkaline water glass in the ratio of 30 g to 25 g at room temperature in a plastic beaker with 5 cm in diameter and 10 cm in height and mixed to a pulp by short stirring (about 1 minute) by means of a spoon. After about 5 minutes a release of gas occurred, giving rise to a formation of foam and an increase in volume, combined with a heating and hardening of the mixture. As the result the increase in volume (measured by the height of the foamed mixture) and the time of reaction were written down. The achieved increase in volume was about 450 %. The hardening to a mechanically stable body happened after about 10 minutes.

What is claimed is:

1. A high-alumina raw material, consisting of
(on dried basis, in weight-%)

Al ₂ O ₃	50 - 80	%
MgO	2 - 15	%
SiO ₂	1 - 15	%
CaO	0.5 - 20	%
Fe ₂ O ₃	0.5 - 2	%
Na ₂ O	0.5 - 2	%
Al (metallic)	0.1 - 2	%
AlN	0.1 - 1	%
K ₂ O	0.1 - 1.5	%
F	0.1 - 2	%
Cl	0.1 - 0.8	%
balance in total maximum	5	%
loss on ignition maximum	15	%

and of the mineral main constituents

aluminium hydroxides	20 - 60	%
corundum α -Al ₂ O ₃	10 - 40	%
spinel MgAl ₂ O ₄	5 - 40	%

wherein the aluminium hydroxides in the form of aluminium mono-hydroxide Al₂O₃.H₂O and aluminium tri-hydroxide Al₂O₃.3H₂O have a weight ratio of more than 0.25.

2. A high-alumina raw material as recited in claim 1, wherein the aluminium mono-hydroxide has the crystal modification of boehmite.

3. A process of producing a high-alumina raw material recited in one of the claims 1 or 2, wherein an alumina product extracted by treating aluminium salt slags, consisting of

(on dried basis, in weight-%)

Al ₂ O ₃	50 - 80	%
MgO	2 - 15	%
SiO ₂	1 - 15	%
Al (metallic)	1 - 5	%
CaO	0.5 - 5	%
Fe ₂ O ₃	0.5 - 2	%
Na ₂ O	0.5 - 2	%
AlN	0.1 - 2	%
K ₂ O	0.1 - 1.5	%
F	0.1 - 2	%
Cl	0.1 - 0.8	%
balance in total maximum	5	%
loss on ignition maximum	15	%
and of the mineral main constituents		
aluminium hydroxides	20 - 50	%
corundum α -Al ₂ O ₃	10 - 40	%
spinel MgAl ₂ O ₄	5 - 40	%

in a particle size of more than 90 weight-% less than 500 μm , with a humidity of more than 25 weight-% water is mechanically densified to a bulk density of more than 1.1 g/cm³ (on dried basis), and treated under humid to hydrothermal conditions at temperatures of minimum 70°C as long as aluminium tri-hydroxide is transformed to aluminium mono-hydroxide and the weight ratio of aluminium mono-hydroxide to aluminium tri-hydroxide is more than 0.25.

4. A process of producing a high-alumina raw material recited in claim 3, wherein the alumina product extracted by treating aluminium salt slags before being mechanically densified is mixed with up to 20 weight-% of burned lime with a particle size of minimum 90 weight-% less than 500 μm .

5. A process of producing a high-alumina raw material recited in claims 3 to 4, wherein the alumina product extracted by treating aluminium salt slags is dried to a remaining humidity of less than 5 weight-% and after that simultaneously mechanically densified and ground by using a vibration mill.

6. Use of a high-alumina raw material recited in one of claims **1** to **2** as sinter active alumina source for producing ceramic and refractory materials, cement, porosified binding agent building materials, slag formers for iron and steel, mineral wool and ceramic fibres.
7. Use of a high-alumina raw material recited in any one of claims **1** to **2**, in mixes with calcium oxide sources, iron oxide sources and silicon oxide sources.
8. Use of a high-alumina raw material recited in claim **7**, wherein the calcium oxide source comprises at least one of lime, limestone, gypsum, anhydrite, dolomite and cement.
9. Use of a high-alumina raw material recited in claim **7** or **8**, wherein the iron oxide source comprises at least one of burnt iron sulfide, haematite, and red mud.
10. Use of a high-alumina raw material recited in claim **7**, **8** or **9** , wherein the silicon oxide source comprises at least one of clay, sand, and fly ash.
11. A mixture for manufacturing ceramic and refractory materials, cement, porosified binding agents, slag formers for iron and steel, mineral wool and ceramic fibers, wherein the mixture comprises the high-alumina raw material of any of claims **1** to **2** and at least one of a calcium oxide source, an iron oxide source and a silicon oxide source.

12. The mixture of claim **11**, wherein the calcium oxide source comprises at least one of lime, limestone, gypsum, anhydrite, dolomite and cement.

13. The mixture of claim **11** or **12**, wherein the iron oxide source comprises at least one of burnt iron sulfide, haematite, and red mud.

14. The mixture of claim **11**, **12** or **13**, wherein the silicon oxide source comprises at least one of clay, sand, and fly ash.

Al ₂ O ₃	50 - 80	%
MgO	2 - 15	%
SiO ₂	1 - 15	%
CaO	0.5 - 20	%
Fe ₂ O ₃	0.5 - 2	%
Na ₂ O	0.5 - 2	%
Al (metallic)	0.1 - 2	%
AlN	0.1 - 1	%
K ₂ O	0.1 - 1.5	%
F	0.1 - 2	%
Cl	0.1 - 0.8	%
balance in total maximum	5	%
loss on ignition maximum	15	%
and of the mineral main constituents		
aluminium hydroxides	20 - 60	%
corundum α-Al ₂ O ₃	10 - 40	%
spinel MgAl ₂ O ₄	5 - 40	%