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[54] **METHOD OF PRODUCING FOUNDRY MOULDS AND CORES**

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[58] **Field of Search**..... 106/38.35, 38.3, 38.5 R, 106/38.9, 38.2, 69

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[57] **ABSTRACT**

A method of producing foundry moulds and cores comprising the steps of preparing a mixture containing a moulding sand, an ingredient chosen from the group which consists of ligno sulphonate of an alkali, alkali-earth metal, ammonium and their mixture as a binder, a material containing aluminate of an alkali metal as a hardener and water, making moulds and cores from said mixture and weathering to harden. The material containing aluminate of an alkali metal is an intermediate product obtainable in the production of aluminum oxide from bauxite or nepheline ores. According to the invention the foundry moulds and cores can be manufactured of a fluid moulding mixture containing a foaming agent apart from said ingredients. To enhance the strength of the moulds and cores the mixture can also contain a water-binding addition, such as cement or carbamide.

5 Claims, No Drawings

METHOD OF PRODUCING FOUNDRY MOULDS AND CORES

The present invention relates to the field of foundry work and more particularly to a method of producing foundry moulds and cores by using a self-hardening moulding sand or mixture.

Well known is a method of producing moulds and cores from a moulding mixture containing moulding sand, sodium silicate and dicalcium silicate. Hardening of this mixture is due to interaction between sodium and dicalcium silicates which results in manufacturing strong cores and moulds (see, for example, French Pat. No. 1,342,529). This prior-art method proves successful in practice though it presents some problems, such as: more difficult decoring of castings, friability of hardened moulds and cores and difficulties related to hardening rate control.

To overcome these problems a method was devised comprising the production of cores and moulds from a self-hardening moulding sand containing ground refractory material, ligno sulphonate of an alkali, alkali-earth metal, ammonium or their mixture, cement and an acid liquor resulting from pyrolysis of wood pulp at gas producing plants. For producing a fluid mixture a foaming agent was added to the above sand (see, for example, Swedish Pat. No. 323,476, Cl. 31*b* 16).

However, this method also presents some difficulties, such as comparatively low hardening rates of the moulds and cores produced thereof (the hardening process lasts for 5–12 hours) and low strength which does not exceed 0.6 kg/cm^2 within 1 hr after their production.

Commonly known also is a method of making foundry moulds and cores of a moulding sand containing ground refractory material, ligno sulphonate of an alkali, alkali-earth metal, ammonium or their mixture as a binder, a compound of hexavalent chromium as a hardener, a foaming agent and water.

The problems associated with the above method are attributed in the first place to low gas permeability of the moulds and cores produced by the above technique necessitating thereby drying at a 150°–200° C temperature for 1.5–2 hrs.

Moreover, the compound of hexavalent chromium employed as the hardener being toxical, some caution is necessary in the use of this hardener.

It is an object of the present invention to overcome or at least to diminish the above difficulties.

The principal object of this invention is to provide such a method of producing foundry moulds and cores of a self-hardening sand, which will ensure substantial enhancement of both mechanical-and-physical properties of said moulds and cores and of their hardening rate. Besides, it would be preferable to avoid the packing operation in making foundry moulds and cores.

According to the invention, this is achieved by the fact that in preparing a mixture containing moulding sand, ligno sulphonate of an alkali, alkali-earth metal, ammonium or their mixture as a binder, a material containing alkali metal aluminate is employed as a hardener.

Due to the reaction between ligno sulphonate and aluminate of an alkali metal, the foundry moulds and cores produced thereof feature high strength, the hardening process being effected at a perceptibly higher rate.

In a preferred embodiment of the present invention it is useful to employ the alkali metal aluminate amounting to within 0.5–5.0 percent of the weight of the moulding sand. This will ensure the maximum possible strength of the foundry moulds and cores produced thereof. Sound practice would be to choose a sodium-aluminate-containing material for that purpose, the materials being most commonly used in the industry. Thus, an intermediate product obtained in the production of aluminium oxide from bauxite or nepheline ores would be preferable for use as the material containing an alkali metal aluminate. The above product is produced by sintering bauxite or nepheline ores mixed with sodium carbonate and limestone at a temperature of 1,200° C. Next the resulting product hereinafter referred to in the description as accordingly a "bauxite sinter" or a "nepheline sinter" is cooled and ground to grain size of 0.3–1 mm.

The foregoing grain size is preferred with the mould and core making technique conforming to the present invention.

The chemical and mineralogical composition of the sinters are presented in the Table.

With the use of these sinters both the mixture strength and its hardening rate depends on the amount of sodium aluminate contained therein. Naturally the higher the content of sodium aluminate in said sinters, the higher are the strength and hardening rate of the moulding mixture.

The quantity of the sinter which should be introduced into the mixture in order to secure the requisite strength and hardening rate of the moulds and cores ranges from 3 to 10 parts by weight to provide the sodium aluminate content of 0.5 to 5 percent respectively of the moulding sand weight.

According to this invention, ligno sulphonate of an alkali, alkali-earth metal, ammonium or their mixture is employed as a binder. The most widely known material containing sodium, calcium, ammonium ligno sulphonate or their mixture is the waste product resulting from the production of cellulose from wood pulp by the sulphite process. Hereinafter in the description the product will be referred to as a "sulphite alcohol waste liquor."

Maximum efficiency is attained with the ligno sulphonate content ranging from 1 to 5 percent of the weight of the moulding sand.

The sulphite alcohol waste liquor employed in the moulding mixture in accordance with the invention comes from the industry either in a liquid form or in the form of dry concentrates, the ligno sulphonate content varying from 45 to 97 percent by weight. The higher the ligno sulphonate contents in the sulphite alcohol waste liquor, the smaller shall be its amount in the mixture to attain the same strength characteristics of the moulds and cores. The ligno sulphonate content in the liquid sulphite alcohol waste liquor may be characterized by its specific gravity. According to the present invention, the moulding mixture contains commonly an aqueous solution of the sulphite alcohol waste liquor of a specific gravity of 1.10–1.27 g/cm^3, the ligno sulphonate content of the solution ranging from 25 to 55 percent by weight which corresponds to its content in the mixture of from 1 to 5 percent of the weight of the moulding sand.

Cited below are exemplary embodiments of this invention in which the sulphite alcohol waste liquor is

employed as ligno sulphonate. It should be borne in mind that the present invention is in no way limited by the use of this particular ligno sulphonate-containing material thereof.

TABLE

Sinter	Chemical composition, % by weight				
	SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O
Bauxite sinter	10–12	29–31	10–11	20–22	21–25
Nepheline sinter	24–26	15–17	2–3	43–46	9–10

	Mineralogical composition, % by weight		
	Dicalcium silicate	Sodium Aluminate	Sodium ferrite
Bauxite sinter	40–55	30–45	8–17
Nepheline sinter	70–80	10–25	2–8

EXAMPLE I

100 parts by weight of quartz sand are mixed for 1.5–2.0 min. with 4.0 parts by weight of a sulphite alcohol waste liquor of a specific gravity of 1.24–1.26 g/cm³ containing accordingly 48–52 percent by weight of ligno sulphonate, and tempered with 2.0 parts by weight of water. Then 2.5 parts by weight of a bauxite sinter and 40 percent by weight of sodium aluminate are added to the mixture and stirring is continued for 0.5–2.0 min.

The mixture being charged in a core or moulding box, a mould or a core is produced in a conventional manner. Next the mould or the core is left to harden in air.

The compression strength (kg/cm²) of the moulding sand amounts to:

after air hardening for 1 hr.	4.5;
after air hardening for 3 hrs.	6.5;
after air hardening for 24 hrs.	9.0.

The strength of the moulds and cores produced thereof can be improved by introducing a known addition into the hardener to bind water in the mixture.

As to the suitable additions, use may be made of loam, bentonite, cement or gypsum to be introduced in amounts ranging from 0.5 to 5 percent of the weight of the moulding mixture.

EXAMPLE 2

100 parts by weight of quartz sand are mixed for 1–2 min. with 4.0 parts by weight of a sulphite alcohol waste liquor of a specific gravity of 1.24–1.26 g/cm³ containing accordingly 48–52 percent by weight of ligno sulphonate, and with 2.0 parts by weight of water. Then 2.5 parts by weight of a bauxite sinter, containing 40 percent by weight of sodium aluminate, and 1.5 parts by weight of cement are added to the mixture and stirring is continued for 2–3 min.

The compression strengths of the moulds and cores produced from the said mixture by the conventional method and left to harden in air were as follows (kg/cm²):

after air hardening for 1 hr.	5.5;
after air hardening for 3 hrs.	7.0;
after air hardening for 24 hrs.	10.5

A method of hardening the binder — ligno sulphonate of an alkali, alkali-earth metal, ammonium or their mixture in accordance with the invention, is of particular importance for fluid moulding sands which, apart from the moulding sand, said ligno sulphonate and the material containing alkali metal aluminate, include a foaming agent introduced in the mixture in quantities large enough to pass the mixture to a fluid state.

The amount of the foaming agent ranges within 0.4–1 percent of the weight of the moulding sand.

The foaming agents added to the moulding mixture may constitute anion, cation and nonionogenic surface-active materials. These may be alkyl aryl sulphonates, alkyl sulphonates, primary and secondary alkyl sulphates, the products of oxyethylation of alcohols, phenols, amines, quaternary ammonium compounds of long-chain fatty amines.

The most suitable foaming agent is an anion-type surface-active compound, such as sodium alkyl aryl sulphonate ensuring the production of a fluid moulding mixture featuring high flowability and the requisite foam stability in the mixture, i.e., the property to retain mobility during the length of time needed to pour the mixture into core and moulding boxes. An advantage of the fluid moulding sand is its high flowability by which virtue the conventional sand compacting technique can be dropped to be replaced by pouring the sand into the core boxes and on patterns during the production of the moulds and cores.

It should be noted that ligno sulphonate of an alkali, alkali-earth metal, ammonium or their mixture employed according to the invention in the manufacture of moulds and cores as a binder, possesses some foaming capacity, being thereby capable of imparting the mixture a better flowability when it is subjected to intense stirring during preparation.

By using said binder and by adding a small amount of the foaming agent the fluid moulding mixture is especially simple in production.

EXAMPLE 3

A fluid mixture can be prepared by mixing 100 parts by weight of quartz sand, 4.0 parts by weight of a sulphite alcohol waste liquor of a specific gravity of 1.24–1.26 g/cm³ containing accordingly from 48 to 52 percent by weight of ligno sulphonate, 0.6 parts by weight of sodium alkyl aryl sulphonate and 2.0 parts by weight of water, the mixing operation lasting for 3–4 min. After the sand has passed to a fluid state 2.5 parts by weight of a bauxite sinter are introduced into it, the sinter containing 40 percent by weight of sodium aluminate. Then the sand is poured into core and moulding boxes and is subjected to air hardening.

The bench life of the fluid moulding mixture, i.e., the length of time during which it retains fluidity, ranges from 4 to 10 min. High gas permeability of the mixture amounting to 200–300 units is attributed to higher porosity.

The compression strength (kg/cm²) of the moulds and cores produced thereof amounts to:

within 1 hr. after manufacture	3.0;
within 3 hrs. after manufacture	5.0;
within 24 hrs. after manufacture	7.0.

Conforming to this invention, the overall strength of the cores can be increased by carbamide introduced into the moulding mixture.

The best results are obtained when adding from 0.8 to 2.0% of carbamide (of the weight of the moulding sand).

We have found that the use of carbamide for improving the strength of the moulds and cores made from a fluid self-hardening sand containing the foaming agent, can reduce appreciably sand humidity; the amount of water added to the sand can be also decreased by 1.0–2.0 percent of the weight of the moulding sand.

EXAMPLE 4

100 parts by weight of quartz sand are mixed with 4.0 parts by weight of a sulphite alcohol waste liquor of a specific gravity of 1.24–1.26 g/cm³ containing accordingly 48–52 percent by weight of ligno sulphonate, the liquor being preliminarily tempered with 1.0 parts by weight of water in which 0.8 parts by weight of powdered carbamide were dissolved.

Within 1.5–2 min. 2.5 parts by weight of a bauxite sinter containing 40 percent by weight of sodium aluminate are introduced into the moulding mixture.

The moulds and cores made from said mixture featured the following compression strength (kg/cm²):

after air hardening for 1 hr.	3.5;
after air hardening for 3 hrs.	7.0;
after air hardening for 24 hrs.	13.5.

EXAMPLE 5

To prepare a fluid moulding sand added to the composition disclosed in Example 4 are 0.6 parts by weight of a foaming agent — sodium alkyl aryl sulphonate. After the moulding mixture has passed to the fluid state 2.5 parts of a hardening agent — a bauxite sinter, containing 40% by weight of sodium aluminate — are introduced into the sand.

Said moulding mixture ensures the following compression strength (kg/cm²) of the moulds and cores produced thereof:

after air hardening for 1 hr.	3;
after air hardening for 3 hrs.	6.5;
after air hardening for 24 hrs.	12.0.

An important merit of the present invention consists in that the strength of foundry moulds and cores will feature a 1.5–2-fold increase along with a two-fold increase in the hardening rates.

Peculiar to the cores produced in accordance with the invention is good knockout.

What we claim is:

1. A method of producing foundry moulds and cores comprising the steps of preparing a mixture containing 100 parts by weight of moulding sand, from 1 to 5 parts by weight of an ingredient selected from the group which consists of ligno sulphonates of an alkali, alkali-earth metal, ammonium and their mixture as a binder, and from 3 to 10 parts by weight of a material containing alkali metal aluminate making moulds and cores from said mixture and holding it for air hardening.

2. A method as of claim **1**, in which the aluminate of an alkali metal is sodium aluminate.

3. A method as of claim **1**, in which the material containing aluminate of an alkali metal is a bauxite sinter.

4. A method as of claim **1**, in which the material containing aluminate of an alkali metal is a nepheline sinter.

5. A method as of claim **1**, in which ligno sulphonate is a sulphite alcohol waste liquor.

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