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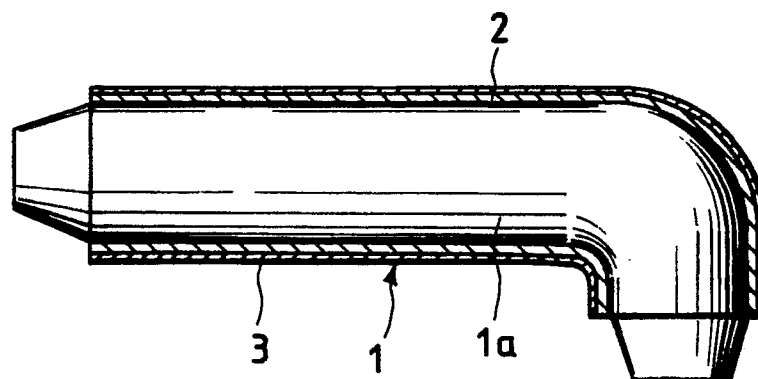
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(54) **Slurry for forming interlayer for collapsible core, method of production of collapsible core using same and collapsible core produced thereby.**

(57) An collapsible core (1) is formed in such a manner that a sand core (1a) is dipped into an acidic suspension having a pH of 5.2 to 6.8 to form an interlayer (2), that the interlayer (2) is coated with an outer layer (3) and that both layers (2, 3) are heat-cured simultaneously.

FIG. 1



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SLURRY FOR FORMING INTERLAYER FOR COLLAPSIBLE CORE, METHOD OF PRODUCTION OF COLLAPSIBLE CORE USING SAME AND COLLAPSIBLE CORE PRODUCED THEREBY

BACKGROUND OF THE INVENTION

The present invention relates to a slurry for forming an interlayer for a collapsible core used in pressure casting such as die casting, a method of producing a collapsible core using the slurry and a collapsible core produced by the method.

In pressure casting of automobile parts having complicated shapes such as a cylinder head, a cylinder block and a water pump body, a core has hitherto been used which is endurable to pressure of molten materials upon casting and can be collapsed after casting, making it easy to remove the core from casted products.

Known collapsible cores are those comprising a sand core shaped with a binder, which has thereon at least one interlayer and further thereon a heat-cured coating of an aqueous solution of synthetic mica. The interlayer is formed for imparting pressure-resistance to the surface of the core. The coating of the synthetic mica solution optionally containing a natural mica, flaky graphite or a metal powder is formed to prevent molten materials from coming (or invading) into the interlayer and to reduce the affinity for the molten materials. For example, a collapsible core having a single interlayer formed thereon by using a suspension of a refractory, a water-soluble phenol resin and water is described in Japanese Patent Publication 57-59013 and Japanese Patent Laid-Open Publication 63-171245, and those having a dual interlayer composed of the first layer provided using a suspension containing a refractory, a water-soluble urea resin thereon are described in Japanese Patent Laid-Open Publication 1-133639.

In production of collapsible cores, the interlayer has been desired to have a thickness of 250 to 350 microns for casting at low speed (plunger speed: 0.5 m/sec or less) and high pressure (400 to 1,000 kg/cm²) or a thickness of 170 to 250 microns for casting at low speed and medium pressure (120 to 400 kg/cm²) so as not to be collapsed during casting and to prevent molten materials from coming into the core, but yet to be collapsed upon heat-processings of the core for a short period of time after casting. However, those prepared by the above prior art technique are not satisfactory in this regard.

That is, the interlayer-forming slurry of the Japanese Patent Publication 57-59013 is prepared by adding an alkaline adjustor such as waterglass or aqueous ammonia to a suspension containing a refractory, a water-soluble phenolic resin and water to have a pH of 8.0 to 8.5 and viscosity of 200 to 300 CP as shown in Fig. 6. Therefore, an interlayer having a thickness of 170 to 350 microns cannot be formed by dipping a sand core once into such a low-viscosity slurry, (while dipping twice thickness to 150 to 200 microns). Thus, the slurry has the defect in productivity of cores and it forms an interlayer having a refractory uniformly dispersed therein only with difficulty since such a low-viscosity alkaline slurry exhibits high sedimentation property.

Further, according to the Japanese Patent Publication 57-59013, an aqueous solution of synthetic mica, etc. is coated on the interlayer which has completely been dried and is then dried to form an outer layer, so that the resulting core has poor adhesion between interlayer a and outer layer b in part during casting to allow invasion of molten materials into the interlayer because the outer layer b is flown by the molten materials. At the same time, blow holes tend to be formed in the casted product by heat of molten materials due to evaporation of water adsorbed in the alkaline interlayer which is highly hygroscopic.

Furthermore, the core with the interlayer composed of a phenolic resin, which has high heat resistance and is decomposed at a temperature of more than 400 degree C, requires a long heat-processing time for collapsing (for example, for 4 hours at 400 degree C in the case of low-speed/medium-pressure casted products and for 4 hours at 500 degree C in some cases), encountering various problems such as deformation of casted products and reduction in production efficiency.

The slurry of the Japanese Patent Laid-Open Publication 63-171245 is a suspension prepared by mixing a refractory, an alcoholic phenolic resin solution and water and provides an interlayer containing the highly heat-resistant phenolic resin, encountering the same problems as described above. It takes a long heat-processing time to allow the resulting core to be collapsed, for example, 2 hours at 400 degree C in the case of low-speed/high-pressure casted products.

The interlayer-forming slurry of the Japanese Patent Laid-Open Publication 1-133639 is a simple mixture of a refractory, a water-soluble urea resin and water and has low viscosity so that a thick interlayer cannot be formed by one dipping of a sand core therein but it can be formed by several times of dipping. Further, according to the Japanese Patent Laid-Open Publication 1-133639, a phenolic resin or a urea resin

is coated on the surface of interlayer, taking a long time to produce cores.

SUMMARY OF THE INVENTION

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An object of the present invention is to provide a slurry for forming an interlayer for collapsible cores, which is capable of forming a uniform interlayer having a desired thickness on a sand core by one dipping of the sand core therein by way of controlling a pH of the slurry within the acidic region.

10 Another object of the present invention is to provide a collapsible core and a method of producing the core, which are free from formation of blow holes, enhance adhesion between an interlayer and an outer layer to prevent invasion of molten materials into the core during casting and require for collapsing after casting only a short heat-processing time one half or less than that in the case of conventional cores in the low-speed/medium-pressure casting or requires no heat-processings for collapsing in the low-speed/high-

15 pressure casting.
According to one aspect of this invention, there is provided a slurry for forming an interlayer on a surface of a collapsible core by dipping the core thereinto, which comprises: a suspension containing at least a refractory, a water-soluble urea resin and water; and an acidic adjustor added to said suspension, said suspension and acidic adjustor being mixed with each other to adjust a pH of said suspension, thereby
20 controlling viscosity of said suspension.

According to another aspect of this invention, there is provided a slurry for forming an interlayer on a surface of a collapsible core by dipping the core thereinto, which comprises: a suspension containing at least a refractory, a water-soluble urea resin and water; an acidic adjustor added to said suspension; and an alkaline adjustor added to an acidic suspension including said acidic adjustor in a region where said
25 suspension is kept acidic, thereby controlling viscosity of said suspension.

According to still another aspect of this invention, there is provided a method of producing a collapsible core, which comprises the steps of: preparing a slurry for forming an interlayer on a surface of a collapsible core by dipping the core thereinto, which comprises a suspension containing at least a refractory, a water-soluble urea resin and water, and an acidic adjustor added to said suspension, said suspension and acidic
30 adjustor being mixed with each other to adjust a pH of said suspension, thereby controlling viscosity of said suspension; preparing a sand core shaped by using a binder; coating said slurry on the surface of said sand core; semi-drying the slurry on the surface of said sand core to form an interlayer; coating on the surface of said interlayer a slurry containing at least an aqueous solution of synthetic mica thereby to form an outer layer; and heat-curing said interlayer and said outer layer simultaneously.

35 According to still another aspect of this invention, there is provided a method of producing a collapsible core, which comprises the steps of: preparing a slurry for forming an interlayer on a surface of a collapsible core by dipping the core thereinto, which comprises a suspension containing at least a refractory, a water-soluble urea resin and water, an acidic adjustor added to said suspension, and an alkaline adjustor added to an acidic suspension including said acidic adjustor in a region where said suspension is kept acidic, thereby
40 controlling viscosity of said suspension; preparing a sand core shaped by using a binder; coating said slurry on the surface of said sand core; semi-drying the slurry on the surface of said sand core to form an interlayer; coating on the surface of said interlayer a slurry containing at least an aqueous sol of synthetic mica thereby to form an outer layer; and heat-curing said interlayer and said outer layer simultaneously.

45 According to still another aspect of this invention, there is provided a collapsible core removed from a product after casting, which comprises: an interlayer formed, on the surface of a shaped sand core using a binder, by coating a slurry which comprises a suspension containing at least a refractory, a water-soluble urea resin and water, and an acidic adjustor added to said suspension, said suspension and acidic adjustor being mixed with each other to adjust a pH of said suspension, thereby controlling viscosity of said suspension, and by semi-drying the slurry on the surface thereof; and an outer layer formed by coating on
50 the surface of said interlayer a slurry containing at least an aqueous solution of synthetic mica, said interlayer and said outer layer being heat cured simultaneously to form at the interface a diffusion layer in which a component of the interlayer is diffused into said outer layer.

According to still another aspect of this invention, there is provided a collapsible core removed from a product after casting, which comprises: an interlayer formed, on the surface of a shaped sand core using a
55 binder, by coating a slurry which comprises a suspension containing at least a refractory, a water-soluble urea resin and water; and acidic adjustor added to said suspension, and an alkaline adjustor added to an acidic suspension including said acidic adjustor in a region where said suspension is kept acidic, thereby controlling viscosity of said suspension, and by semi-drying the slurry on the surface thereof; and an outer

layer formed by coating on the surface of said interlayer a slurry containing at least an aqueous solution of synthetic mica, said interlayer and said outer layer being heat cured simultaneously to form at the interface a diffusion layer in which a component of the interlayer is diffused into said outer layer.

Further objects, features and other aspects of this invention will be understood from the following detailed description of the preferred embodiments of this invention with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

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In the accompanying drawings:

Fig. 1 illustrates a partial sectional front view of one example of collapsible cores produced by the process of the present invention;

Fig. 2 is an enlarged sectional side view of the above core;

15 Fig. 3 illustrates an enlarged sectional view of an interlayer and an outer layer of the collapsible core of the present invention;

Fig. 4 is a graph showing the relationship between pH and viscosity of an interlayer-forming slurry of the present invention;

20 Fig. 5 illustrates an enlarged sectional view of an interlayer and an outer layer of a conventional collapsible core; and

Fig. 6 is a graph showing the relationship between pH and viscosity of a slurry used in a conventional process for producing cores.

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DETAILED DESCRIPTION OF THE INVENTION

One embodiment of the present invention is explained hereinbelow. A suspension used in preparation of a slurry of the present invention is obtained by mixing a fine powder of refractory comprising zircon flour, a water-soluble urea resin having a decomposition temperature of 200 degree C and water with a stirrer, to thereby uniformly disperse the refractory.

For controlling viscosity of the slurry, there has been known a method wherein the mixing ratio of refractory to water is adjusted. However, when the viscosity is increased by increasing the content of refractory, the resulting slurry undergoes large fluctuation of viscosity due to evaporation of the water during use of the slurry, and it has a drawback in control of the thickness of an interlayer. When the water content is increased to lower the viscosity, a large amount of the water is evaporated during drying of the interlayer which suffers from crazing. It was found through experiments that the optimum mixing ratio is adjusted such that the specific gravity of the slurry is fallen within the range of from 2.6 to 2.8, and that the viscosity of the slurry is not much changed in addition to nonoccurrence of cracks during drying a product.

40 In the embodiment of the present invention, the mixing ratio of the refractory to the water is adjusted to form a suspension having specific gravity of about 2.7, and a pH of the suspension is adjusted by addition of an acidic adjustor (e.g., hydrochloric acid, sulfuric acid, nitric acid, phosphoric acid, and acetic acid) to control viscosity of the suspension such that an interlayer having a desired thickness can be formed on the surface of a sand core by one dipping of the sand core in the suspension.

45 Fig. 4 shows the relationship between pH and viscosity of the suspension. The viscosity reaches a minimum at the pH of about 8 to about 9 and increases more steeply as the pH becomes smaller than about 8 or larger than about 9.

50 It was also found through experiments that the viscosity is needed to be within the range of from 165 to 880 CP so as to form, by one dipping, an interlayer having a thickness of 170 to 350 microns which is endurable to the low-speed/medium- or high-pressure casting. Table 1 shows the relationship between pH, viscosity of the suspension and thickness of the interlayer formed by dipping once.

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Table 1

pH	Viscosity(CP)	Thickness(mm)	Amount of Sediments(wt.%)
4.5	1600	1.1	0
5.2	880	0.35	6.2
6.0	500	0.27	7.7
6.5	260	0.2	11.9
6.7	220	0.19	12.3
6.8	165	0.17	13.7
7.0	140	0.15	41.6
8.0	70	0.11	40.1
9.0	74	0.09	43.2
10.0	106	0.10	41.4
11.0	420	0.17	36.8
11.7	920	1.2	12.5

The above-described suspension without the addition of acidic adjustor has viscosity of about 140 CP at a pH of about 7.0, and one dipping of a sand core into the suspension provides a 150 micron-thick interlayer. In order to attain the above-described viscosity (165 - 880 CP), it is sufficient to adjust the pH within the range of from 5.2 to 6.8 (acid range) or from 10.25 to 11.6 (alkaline range), as will be seen from Fig. 4.

Accordingly, suspensions having a pH of 5.2 to 6.8 and a pH of 10.25 to 11.6 were prepared by adding the above-described acidic adjustor or an alkaline adjustor (e.g., an aqueous solution of sodium hydroxide, aqueous ammonia, and water-glass), and it was confirmed that both the acidic and alkaline suspensions provided interlayers having the desired thickness of 170 to 350 microns by one dipping of a sand core. However, it was noted that the acidic suspension is superior to the alkaline suspension in the dispersibility of refractory in the interlayer and that this preference relies on difference in the amount of sediments in the suspension as shown in Table 1. That is, the suspension having a pH of 5.2 to 6.8 contained 6.2 to 13.7 wt% of sediments, whereas the suspension having a pH of 10.25 to 11.6 contained 36.8 wt.% of sediments. The amount of sediments reaches a maximum (40 wt.% or more) at a pH of about 8 to about 9.

Thus, the refractory can be uniformly dispersed in the acidic suspension for a long time as compared to the alkaline suspension, enabling coating operation of the suspension without stirring for a long time to form an interlayer having the refractory uniformly dispersed therein, which exhibits good pressure-resistance, and in its turn, invasion of molten materials into the core can be prevented. Further, control of the viscosity can be effected merely by adjusting the pH (about 7.0) of the suspension to the range of from 5.2 to 6.8, and because of a little change in the pH needed, the added amount of adjustor is small and thus the viscosity-controlling operation is very easy.

Paying attention to the fact that as the acidity of the suspension increases, the viscosity increases and the amount of sediments decreases, as shown in Table 1 as above, an acidic suspension was prepared by mixing a refractory, a water-soluble urea resin, water and an acidic adjustor, and it was found that the acidic suspension having a pH of 4.5 had remarkably increased viscosity of 1600 CP with substantially no sediments.

An acidic suspension having a pH of 4.2 to 4.6 had viscosity of 1450 to 2420 CP. When the viscous suspension was stirred, high shearing force was realized between the dispersed refractory particles so that the particles did not agglomerate in a short period of time even with low-speed stirring and no sediments were observed for a long time. Therefore, it is advantageous to store the suspension in this state because of easy maintenance and easy control of the suspension quality. A part of this acidic suspension was weighed out to prepare a predetermined amount of slurry to be used, and the pH of the subdivided suspension was adjusted to the acidic region of 5.2 to 6.8 with an alkaline adjustor. Use of the thus prepared suspension provided the same results as in the case of using the above-described suspension whose pH was adjusted to 5.2 to 6.8 by the addition of acidic adjustor.

One embodiment of the method of producing a collapsible core of the present invention is explained with reference to Figs. 1 and 2.

In Figs. 1 and 2, the numeral 1a is a sand core comprising a refractory (e.g., zircon sand, flattery sand, silica sand, and chromite sand), and a curable organic binder (e.g., resins or phenolic resins) or inorganic

binder (e.g., water-glass), which is shaped by a shell mold process, a cold box process or other conventional processes.

A numeral 2 is an interlayer which is formed by dipping the above-described sand core 1a in the above-described interlayer-forming slurry, semi-drying the resulting coating on the core and heat-curing it together with a coating of an outer layer-forming slurry provided on the semi-dried coating by dipping in the outer layer-forming slurry.

The interlayer is semi-dried, before coating the outer layer-forming slurry thereon, by allowing it to stand at a room temperature for 60 minutes or by heating with various means at 60 degree C for 20 minutes, at 50 degree C for 40 minutes or at 80 degree C for 10 minutes.

A numeral 3 is an outer layer formed by dipping the sand core which has been covered with a semi-dried interlayer, in the outer layer-forming slurry, followed by heat-curing.

The outer layer-forming slurry is conventional one mainly composed of synthetic mica. For the ingredient, a mixture of a synthetic mica and natural mica, a mixture of a synthetic mica and a metal powder, a mixture of a synthetic mica, natural mica and a metal powder, a mixture of a synthetic mica, flaky graphite and a metal powder, or a mixture of a synthetic mica, natural mica, flaky graphite and a metal powder may be used.

Examples of the metal powder include aluminum powder, stainless steel powder and the like, which function to prevent more effectively invasion of molten materials into the interlayer 2.

The outer layer 3 preferably has a thickness of about 50 microns. The semi-dried interlayer 2 and the outer layer 3 are completely cured by heating to a temperature of not higher than 200 degree C at which the water-soluble urea resin in the interlayer 2 is not decomposed. Taking the heating time into consideration, the heat-curing is preferably performed at a temperature of 130 to 200 degree C and, in the case, the heating time is 10 to 30 minutes.

Next, the collapsible core 1 produced by the above-described process is explained below.

The collapsible core 1 of the present invention has the interlayer 2 which has been coated in its semi-dry state with an outer layer-forming slurry and heat-cured together with the coated outer layer 3 thereon, so that the water-soluble urea resin 2a and water of the semi-dried interlayer 2 are diffused into the outer layer 3 and cured simultaneously to form a diffusion layer m as if the component of the interlayer took root between particles 3a of e.g., mica in the outer layer 3, as shown in Fig. 3, whereby the adhesion between the two layers is enhanced and peeling of the outer layer due to molten materials upon casting is completely prevented, and in turn, the invasion of molten materials into the core is completely prevented.

Since the interlayer-forming slurry of the present invention is acidic, the resulting interlayer 2 is less hygroscopic than that formed with an alkaline slurry. For the reason, formation of blow-holes in the casted product can be effectively prevented, which takes place by evaporation of water in an interlayer 2 due to heat of molten materials during casting.

A hygroscopicity test was performed in the following manner: three test specimens (100 mm × 10 mm × 10 mm) were prepared using the interlayer-forming slurry of the present invention having a pH of 6, an interlayer-forming slurry having a pH adjusted to 11 with sodium hydroxide or water-glass; they were allowed to stand at a humidity of 70 %RH for one day; and the increase in weight of each test specimen due to absorption of humidity was measured. The results are shown in Table 2.

Table 2

Test Specimen	Acidic Slurry of Invention (g)	Alkaline Slurry	
		NaOH (g)	Water-glass (g)
No. 1	0.1	0.2	0.6
No. 2	0.1	0.5	0.5
No. 3	0.0	0.2	0.5
No. 4	0.1	0.3	0.5
No. 5	0.1	0.2	0.5
average	0.08	0.28	0.52

It is seen from the results that the increases in weight of the test specimens prepared using the

waterglass-added alkaline slurry and the NaOH-added alkaline slurry are about 7 times and about 3 times, respectively, larger than that of the test specimen of the present invention.

In addition, the interlayer of the present invention is composed of a water-soluble urea resin which has a low decomposition temperature, and, therefore, the heat-processing time can be remarkably shortened for collapsing of the core to remove it from a casted product. Low-speed/medium-pressure casting (Experiment Nos. 1 to 3) and low-speed high-pressure casting (Experiment Nos. 4 and 5) were carried out using various cores, and the results are shown in Table 3.

Table 3

Experiment No.	1	2	3
(Sand Core)			
Shaping method	shell mold	cold box	cold box
Sand (parts)	zircon sand (100)	zircon sand (100)	flattery sand (100)
Resin (parts)	Phenolic resin (0.8)	Phenolic resin (0.7) + Polyisocyanate (0.7)+TEA	Phenolic resin (0.6) + Polyisocyanate (0.6)+TEA
(Slurry for Interlayer)			
Zircon flour*1	60 parts	55 parts	50 parts
Zircon flour*2	40 parts	45 parts	50 parts
60% Urea resin (weak alkali)	5 parts	4 parts	3 parts
Water(solvent)	20 parts	20 parts	20 parts
Defoaming agent	a little	a little	a little
Surfactant	0.2 part	0.3 part	0.2 part
pH	6.3	6.7	6.64
Specific gravity	2.67	2.73	2.71
Drying temp. × Time (degree C×min.)	60 × 30	50 × 40	80 × 10
(Slurry for outer layer)			
Natural mica	none	20 parts	30 parts

5	Flaky graphite	30 parts	none	10 parts
	Synthetic mica	20 parts	20 parts	20 parts
	Water	50 parts	40 parts	60 parts
10	Defoaming agent	a little	a little	a little
	Surfactant	0.2 part	0.3 part	0.2 part
	Metal powder	stainless steel powder (10 parts)	none	none
15				
	Drying temp. x Time (degree C x min.)	200 x 10	150 x 20	150 x 20
20				
25	(Casting Condition)			
	Al alloy	AC2B	ADC10	ADC10
	Melting temp. (degree C)	720	680	700
30				
	Casting pressure (kg/cm ²)	200	250	120
35				
	Plunger speed (m/sec.)	0.07	0.12	0.10
40				
	Machine	vertical type	vertical type	vertical type
	Heat Processing (degree C x hour)	400 x 2	500 x 1.5	500 x 1.5
45				
	Casted Product	cylinder head	cylinder block	cylinder block
50				

Table 3 (cont'd)

Experiment No.	4	5
(Sand Core)		
Shaping method	CO ₂ method	shell mold
Sand (parts)	silica sand	flattery sand
	(100)	(100)
Resin (parts)	Waterglass	Phenolic resin(2.0)
(Slurry for Interlayer)		
Zircon flour*1	60 parts	50 parts
Zircon flour*2	40 parts	50 parts
60% Urea resin	2 parts	3 parts
(weak alkali)		
Water(solvent)	20 parts	20 parts
Defoaming agent	a little	a little
Surfactant	0.3 part	0.2 part
pH	5.4	5.6
Specific gravity	2.69	2.7
Drying temp.	60 × 20	80 × 20
× Time		
(degree C×min.)		
(Slurry for outer layer)		
Natural mica	30 parts	none
Flaky	5 parts	30 parts
graphite		

5	Synthetic mica	20 parts	20 parts
	Water	60 parts	60 parts
	Defoaming agent	a little	a little
10	Surfactant	0.2 part	0.5 part
	Metal powder	Al powder	Al powder
		(10 parts)	(5 parts)
15	Drying temp. X	160 X 20	150 X 30
	Time		
	(degree CXmin.)		
20	(Casting Condition)		
	Al alloy	AC2B	ADC10
25	Melting temp.	740	670
	(degree C)		
	Casting pressure	1,000	600
30	(kg/cm ²)		
	Plunger speed	0.18	0.35
35	(m/sec.)		
	Machine	vertical	horizontal
		type	type
40	Heat Processing	none	none
	Casted Product	cylinder	water pump
45		head	body

[NOTE]*1 particle size: 1 micron

*2 particle size: 10 micron

Experiment 1

A sand core was dipped once into an interlayer-forming slurry having specific gravity of 2.67 and a pH

of 6.3 to form an interlayer of 220 microns in thickness. The thus prepared collapsible core was assembled in a mold of a vertical die casting machine, with which a cylinder head was casted at a low speed and a medium pressure of 200 kg/cm². Then, the casted product was subjected to heat processing at 400 degree C for 2 hours, so that the core was collapsed and easily removed from the casted product.

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Experiment 2

A sand core was dipped once into an interlayer-forming slurry having specific gravity of 2.73 and a pH of 6.7 to form an interlayer of 190 microns in thickness. The thus prepared collapsible core was assembled in a mold of a vertical die casting machine, with which a cylinder block was casted at a low speed and a medium pressure of 250 kg/cm². Then, the casted product was subjected to heat processing at 500 degree C for 1.5 hours, so that the core was collapsed and easily removed from the casted product.

15

Experiment 3

A sand core was dipped once into an interlayer-forming slurry having specific gravity of 2.71 and a pH of 6.64 to form an interlayer of 200 microns in thickness. The thus prepared collapsible core was assembled in a mold of a vertical die casting machine, with which a cylinder block was casted at a low speed and a medium pressure of 120 kg/cm². Then, the casted product was subjected to heat processing at 500 degree C for 1.5 hours, so that the core was collapsed and easily removed from the casted product.

Experiment 4

A sand core was dipped once into an interlayer-forming slurry having specific gravity of 2.69 and a pH of 5.4 to form an interlayer of 320 microns in thickness. The thus prepared collapsible core was assembled in a mold of a vertical die casting machine, with which a cylinder head was casted at a low speed and a high pressure of 1,000 kg/cm². The core was easily removed from the casted product without any heat processing.

Experiment 5

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A sand core was dipped once into an interlayer-forming slurry having specific gravity of 2.70 and a pH of 5.6 to form an interlayer of 290 microns in thickness. The thus prepared collapsible core was assembled in a mold of a horizontal die casting machine, with which a water pump body was casted at a low speed and a high pressure of 600 kg/cm². The core was easily removed from the casted product without any heat processing.

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While the above Experiments are directed to collapsible cores having an interlayer provided directly on the surface of a sand core, the interlayer-forming slurry of the present invention should not be construed to be limited for the application of such two-layered cores but may be applied for three-layered cores wherein the interlayer is provided on the surface of a sand core which has been dipped, for example, in an aqueous solution of zircon flour to seal the components of the interlayer against invasion into the sand core to prevent deterioration of collapsible property thereof.

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According to the present invention wherein an acidic adjustor is added to a suspension to control its viscosity, whereby an interlayer-forming slurry for collapsible cores is prepared, an interlayer having a desired thickness endurable to low-speed and medium- or high-pressure casting can be formed merely by dipping a sand core once in the slurry. Further, since the slurry undergoes little sedimentation, an interlayer having a refractory uniformly dispersed therein and exhibiting excellent pressure resistance can be easily formed.

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The collapsible core, as another embodiment, of the present invention is produced by the process comprising coating an outer layer-forming slurry on the interlayer in a semi-dried state and heat-curing the semi-dried interlayer and the outer layer simultaneously, so that the water-soluble urea resin of the interlayer is diffused between particles such as mica in the outer layer, whereby the adhesion between the layers are enhanced to completely prevent invasion of molten materials into the core. Further, the interlayer of the present invention is acidic and less hygroscopic as compared to an alkaline interlayer, and therefore,

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formation of blow holes in the core due to evaporation of water can be minimized. Furthermore, the interlayer is composed of a water-soluble urea resin which is decomposed at a low temperature, so that the core can be removed from a casted product by heat processing for a short period of time, less than one half that in conventional heat processing. In particular, the core which has been subjected to low-speed and high-pressure casting is readily collapsed due to the casting temperature and pressure and thus the subsequent heat processings can be omitted to remove the core from a casted product.

Claims

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1. A slurry for forming an interlayer (2) on a surface of a collapsible core (1) by dipping the core (1a) thereinto, characterized by:

- a) a suspension containing at least a refractory, a water-soluble urea resin and water; and
- b) an acidic adjustor added to said suspension,

15 said suspension and acidic adjustor being mixed with each other to adjust a pH of said suspension, thereby controlling viscosity of said suspension.

2. A slurry according to claim 1, wherein said acidic adjustor comprises hydrochloric acid, sulfuric acid, nitric acid, phosphoric acid or acetic acid.

3. A slurry according to claim 1, wherein said suspension has a pH of 5.2 to 6.8.

20 4. A slurry for forming an interlayer (2) on a surface of a collapsible core (1) by dipping the core (1a) thereinto, characterized by:

- a) a suspension containing at least a refractory, a water-soluble urea resin and water;
- b) an acidic adjustor added to said suspension; and
- c) an alkaline adjustor added to an acidic suspension including said acidic adjustor in a region where said suspension is kept acidic, thereby controlling viscosity of said suspension.

25 5. A slurry according to claim 4, wherein said acidic suspension has a pH of 4.2 to 4.6 and said alkaline adjustor is added to said acidic suspension so that said acidic suspension has a pH of 5.2 to 6.8.

6. A method of producing a collapsible core (1), characterized by the steps of:

- a) preparing a slurry for forming an interlayer on a surface of a collapsible core (1) by dipping the core (1) thereinto, which comprises a suspension containing at least a refractory, a water-soluble urea resin and water, and an acidic adjustor added to said suspension, said suspension and acidic adjustor being mixed with each other to adjust a pH of said suspension, thereby controlling viscosity of said suspension;
- b) preparing a sand core shaped by using a binder;
- c) coating said slurry on the surface of said sand core (1a);
- d) semi-drying the slurry on the surface of said sand core (1a) to form an interlayer (2);
- e) coating on the surface of said interlayer (2) a slurry containing at least an aqueous solution of synthetic mica thereby to form an outer layer (3); and
- f) heat-curing said interlayer (2) and said outer layer (3) simultaneously.

7. A method according to claim 6, wherein said interlayer is semi-dried by allowing it to stand at a room temperature for 60 minutes or by heating at 60 degree C for 20 minutes, at 50 degree C for 40 minutes, or at 80 degree C for 10 minutes.

8. A method according to claim 6, wherein said interlayer and said outer layer are heat-cured at a temperature of 130 to 200 degree C.

9. A method of producing a collapsible core, characterized by the steps of:

- a) preparing a slurry for forming an interlayer on a surface of a collapsible core (1) by dipping the core (1a) thereinto, which comprises a suspension containing at least a refractory, a water-soluble urea resin and water, an acidic adjustor added to said suspension, and an alkaline adjustor added to an acidic suspension including said acidic adjustor in a region where said suspension is kept acidic, thereby controlling viscosity of said suspension;
- b) preparing a sand core (1a) shaped by using a binder;
- c) coating said slurry on the surface of said sand core (1a);
- d) semi-drying the slurry on the surface of said sand core (1a) to form an interlayer (2);
- e) coating on the surface of said interlayer (2) a slurry containing at least an aqueous solution of synthetic mica thereby to form an outer layer (3); and
- f) heat-curing said interlayer (2) and said outer layer (3) simultaneously.

10. A method according to claim 9, wherein said interlayer (2) is semi-dried by allowing it to stand at a room temperature for 60 minutes or by heating at 60 degree C for 20 minutes, at 50 degree C for 40 minutes, or at 80 degree C for 10 minutes.

11. A method according to claim 9, wherein said interlayer (2) and said outer layer (3) are heat-cured at a temperature of 130 to 200 degree C.

12. A collapsible core removed from a product after casting, characterized by:

- a) an interlayer (2) formed, on the surface of a shaped sand core (1a) using a binder, by coating a slurry which comprises a suspension containing at least a refractory, a water-soluble urea resin and water, and an acidic adjustor added to said suspension, said suspension and acidic adjustor being mixed with each other to adjust a pH of said suspension, thereby controlling viscosity of said suspension, and by semi-drying the slurry on the surface thereof; and
- b) an outer layer (3) formed by coating on the surface of said interlayer (2) a slurry containing at least an aqueous solution of synthetic mica, said interlayer (2) and said outer layer (3) being heat cured simultaneously to form at the interface a diffusion layer (m) in which a component of the interlayer (2) is diffused into said outer layer (3).

13. A collapsible core removed from a product after casting, characterized by:

- a) an interlayer (2) formed, on the surface of a shaped sand core (1a) using a binder, by coating a slurry which comprises a suspension containing at least a refractory, a water-soluble urea resin and water, and acidic adjustor added to said suspension, and an alkaline adjustor added to an acidic suspension including said acidic adjustor in a region where said suspension is kept acidic, thereby controlling viscosity of said suspension, and by semi-drying the slurry on the surface thereof; and
- b) an outer layer (3) formed by coating on the surface of said interlayer (2) a slurry containing at least an aqueous solution of synthetic mica, said interlayer (2) and said outer layer (3) being heat cured simultaneously to form at the interface a diffusion layer (m) in which a component of the interlayer (2) is diffused into said outer layer (3).

FIG. 1

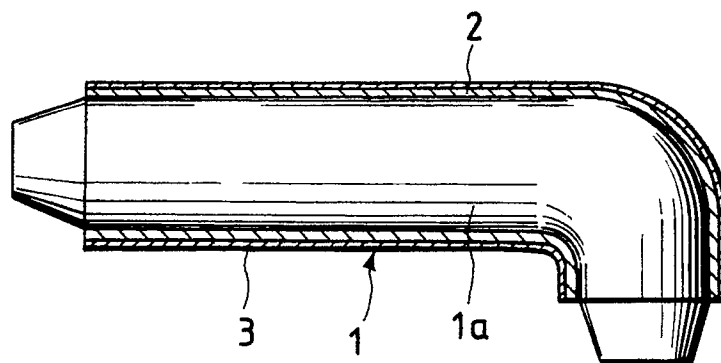


FIG. 2

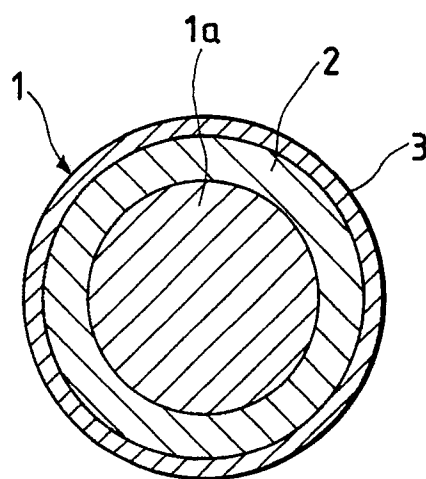


FIG. 3

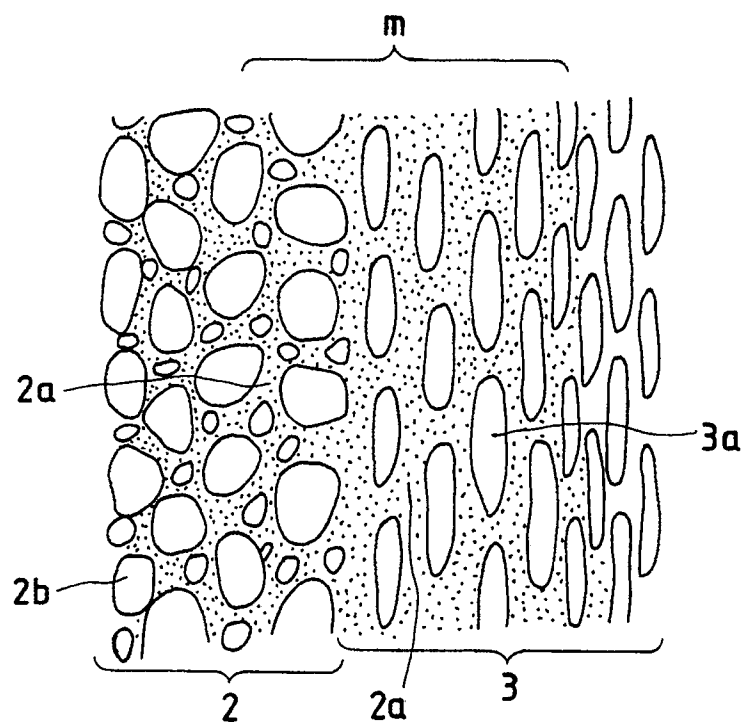


FIG. 5
PRIOR ART

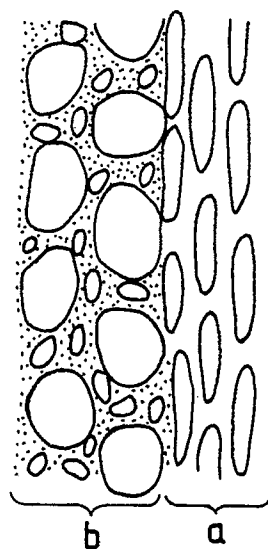


FIG. 4

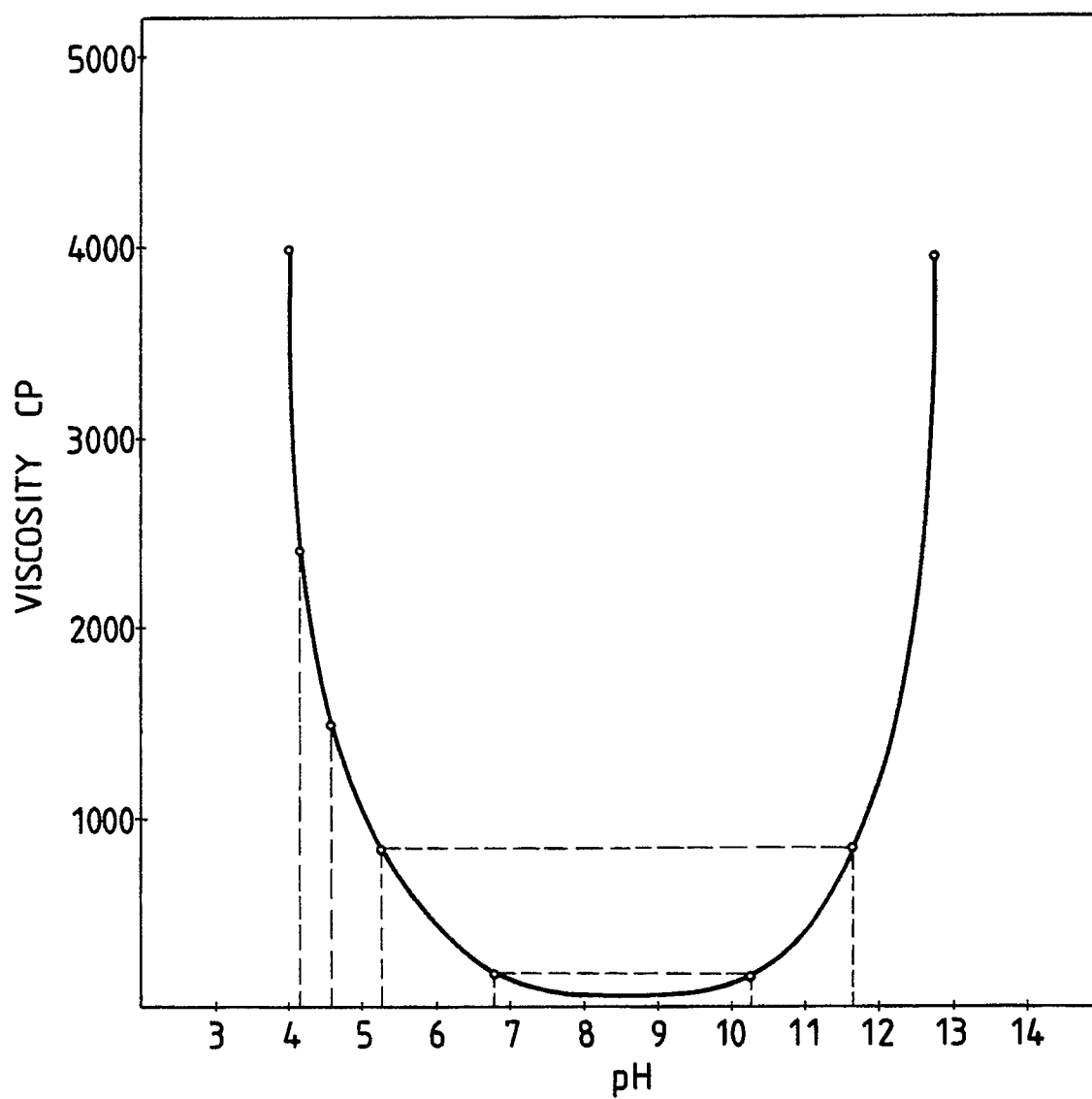


FIG. 6
PRIOR ART

