



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
29.04.2020 Bulletin 2020/18

(51) Int Cl.:
B22C 5/00 (2006.01) B22C 5/14 (2006.01)

(21) Application number: **18820760.9**

(86) International application number:
PCT/JP2018/002613

(22) Date of filing: **29.01.2018**

(87) International publication number:
WO 2018/235324 (27.12.2018 Gazette 2018/52)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD TN

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(30) Priority: **20.06.2017 JP 2017120202**

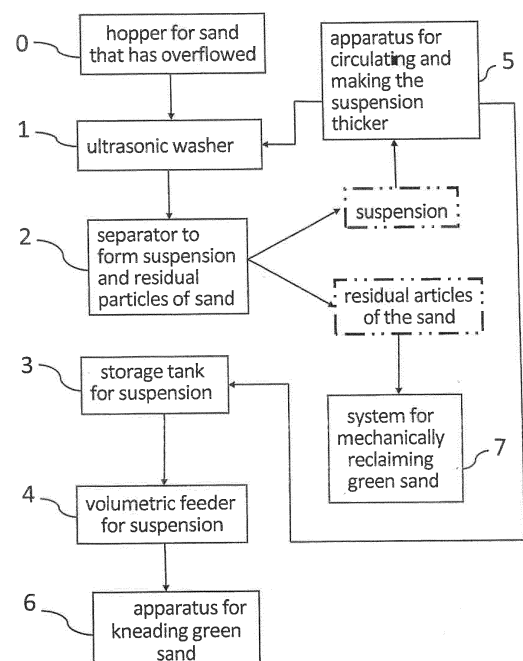
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(54) **WET MOLDING SAND REUTILIZING METHOD AND DEVICE**

(57) A method and an apparatus for effectively reusing the green sand that would otherwise overflow the line for molding to be disposed of, even though it is fully usable, are provided. The method for reusing green sand comprising the steps of treating the green sand with ultrasonic waves in water; separating a mixture that is obtained by the step of treating the green sand with ultrasonic waves to form a suspension and to form residual particles of the sand; circulating the suspension to then proceed to the step of treating the green sand with ultrasonic waves so that the suspension is concentrated; storing the concentrated suspension; and feeding the stored suspension to green sand by a predetermined amount when green sand is mullied.

Fig. 1



Description

Prior-art Publication

Technical Field

Patent Literature

[0001] The present invention relates to a method and an apparatus to efficiently reuse green sand after molding.

5 **[0008]**

Background Art

[Patent Literature 1]
Japanese Patent Laid-open Publication No.
2003-290872
10 [Patent Literature 2]
Published PCT Japanese Translation No.
2004-532129

[0002] In green sand molding, since a core is used, an organic binder that has been used for forming the core dissipates so that a part of the core sand become single grains to be mixed in the green sand. Thus the total amount of the green sand in the line for molding gradually increases, to overflow. Thus the part of the green sand that is used in the line for molding must be disposed of. Further, the clay content is reduced because of the increase of the amount of the green sand. Thus clay must be added. This increases costs.

Summary of Invention

15 (Italics: Claim language)

[0003] In this situation, materials that adhere to the surfaces of the sand are stripped, separated, and removed by mechanical means. Then the sand is reclaimed to be used for molds. The coating materials that have been stripped and separated are collected by a dust collector in the same way as for dust.

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[0004] The coating materials that have been stripped and separated include crushed sand as fine powder and clay that has been denatured by heat from poured molten metal. However, regarding active clay, which is an effective binder, it is difficult to separate it from the coating materials that have been stripped and separated. Thus, as in Patent Literature 1, water is added to dust that has been collected and that includes the coating materials that have been stripped and separated to be reused as a paste-like sealing material for molds. But most of the dust is usually disposed of.

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[0009] A method for reusing green sand of the present invention comprises the step of treating the green sand with ultrasonic waves in water. It also comprises the step of separating to separate a mixture that is obtained by the step of treating the green sand with ultrasonic waves to form a suspension and to form residual particles of the sand. It also comprises the step of circulating to circulate the suspension to then proceed to the step of treating the green sand with ultrasonic waves so that the suspension is concentrated. It also comprises the step of storing to store the concentrated suspension. It also comprises the step of feeding to feed the stored suspension to green sand by a predetermined amount when green sand is mulled.

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[0005] For example, in Patent Literature 2, a method for collecting active clay, which is an effective binder, from the coating materials that have been stripped and separated, is disclosed. In that method collected dust that includes the coating materials that have been stripped and separated is agitated and suspended in water. Then a supernatant liquid that includes bentonite and organic materials is separated. The supernatant liquid is used in a line for molding.

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[0010] By treating green sand with ultrasonic waves, active clay can be efficiently separated from it to obtain a suspension that includes the active clay. By circulating the suspension as water for treating green sand with ultrasonic waves, the suspension can be concentrated. Thus the clay of the green sand can be efficiently reused.

[0011] The method for reusing the green sand of the present invention preferably includes the step of removing an Oolitic layer from the residual particles of the sand that have been separated in the step of separating.

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[0012] By removing the Oolitic layer from the residual particles of the sand, they can be reused as core sand, etc.

[0006] However, these methods are insufficient to reuse green sand that is to be disposed of because of overflow, by efficiently separating active clay, which can be reused.

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[0007] The present invention aims to provide a method and an apparatus for effectively reusing green sand that would otherwise be disposed of because of overflow, even though it is usable.

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[0013] An apparatus for reusing green sand of the present invention comprises an ultrasonic washer for treating green sand with ultrasonic waves in water, the green sand having been used. It also comprises a separator for separating a mixture that is obtained by the ultrasonic washer to form a suspension and to form residual particles of the sand. It also comprises an apparatus for circulating and making the suspension thicker, which apparatus measures a degree of concentration of the separated suspension, which apparatus returns the suspension to the ultrasonic washer if the degree of concentration that is measured equals, or is below, a predetermined degree of concentration, and which apparatus feeds the suspension to a storage tank for storing the

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suspension if the degree of concentration that is measured is over the predetermined degree of concentration. It also comprises the storage tank that stores the suspension of which the degree of concentration is over the predetermined degree of concentration. It also comprises a volumetric feeder that feeds the stored suspension by a predetermined amount when the green sand is mulled.

[0014] By treating the green sand with ultrasonic waves, active clay is efficiently removed from the green sand to cause the suspension to contain the active clay. By using such a suspension as water for the ultrasonic treatment, the suspension can be concentrated so that the clay can be efficiently used as the clay content of the green sand.

[0015] The apparatus for reusing the green sand of the present invention preferably comprises a system for mechanically reclaiming the green sand that removes an Oolitic layer from the residual particles of the sand that have been separated in the separator.

[0016] By removing the Oolitic layer from the residual particles of the sand, they can be reused as core sand, etc.

[0017] As discussed above, the present invention provides a method for effectively reusing the green sand that would otherwise overflow from the line for molding to be disposed of, even though it is fully usable.

[0018] The basic Japanese patent application, No. 2017-120202, filed June 20, 2017, is hereby incorporated by reference in its entirety in the present application.

[0019] The present invention will become more fully understood from the detailed description given below. However, the detailed description and the specific embodiments are only illustrations of the desired embodiments of the present invention, and so are given only for an explanation. Various possible changes and modifications will be apparent to those of ordinary skill in the art on the basis of the detailed description.

[0020] The applicant has no intention to dedicate to the public any disclosed embodiment. Among the disclosed changes and modifications, those which may not literally fall within the scope of the present claims constitute, therefore, a part of the present invention in the sense of the doctrine of equivalents.

[0021] The use of the articles "a," "an," and "the" and similar referents in the specification and claims are to be construed to cover both the singular and the plural form of a noun, unless otherwise indicated herein or clearly contradicted by the context. The use of any and all examples, or exemplary language (e.g., "such as") provided herein is intended merely to better illuminate the invention, and so does not limit the scope of the invention, unless otherwise stated.

Brief Description of Drawings

[0022]

[Fig. 1] Figure 1 is a system flowchart that illustrates the process for carrying out the work.

[Fig. 2] Figure 2 is a graph that shows rates of collecting active clay from green sand by an ultrasonic treatment.

Description of Embodiments

[0023] Below the present invention is discussed with reference to Fig. 1.

(1) Excess green sand that is generated in a line for molding is transported to a hopper 0 for sand that has overflowed. It is temporarily stored there.

(2) The green sand that has been stored in the hopper for the sand that has overflowed is fed to the ultrasonic washer 1 by means of a device for discharging a fixed amount of the sand. Water that contains no additives, such as a parting agent, is also fed there when the weight of the water is three to ten times the weight of the sand. The reason the water that contains no additives, such as a parting agent, is so fed is based on the cost and toxicity of the additives. If the degree of concentration of the suspension, which is discussed in No. (4) below, is equal to, or below, a reference value, the suspension is supplied to the ultrasonic washer 1. By the ultrasonic washer 1 ultrasonic waves generated at 20 - 400 kHz are applied to the mixture of the green sand and the water for a period that is appropriate for the output of ultrasonic waves by an ultrasonic generator (the step of treating the green sand with ultrasonic waves). The coating materials that adhere to the surfaces of the green sand are stripped by that ultrasonic treatment. Thus the suspension wherein the coating materials that have been stripped are suspended in the water and the residual particles of the sand from which the coating materials have been stripped are obtained.

(3) The mixture of the green sand and the water that has been subjected to the step of treating the green sand with ultrasonic waves is fed to the separator 2 to be separated into the suspension and the residual particles of the sand (the step of separating). The separator 2 may be a separator of a settling-type or of a filtering-type.

(4) The degree of concentration of the suspension is measured. If it is equal to, or below, the reference value, then the suspension is circulated to an apparatus 5 for circulating and making the suspension thicker and fed into the ultrasonic washer 1 so that the suspension is made thicker (the step of circulation). The degree of concentration of the suspension is measured by any known densitometer, such as an optical densitometer that uses reflected light or transmitted light. A fixed amount of the green sand that has been stored in the hopper 0 for the sand that has overflowed is fed to the ultrasonic washer

1., The degree of concentration of the suspension is again measured after the step of treating the green sand with ultrasonic waves and the step of separating. If it is still equal to, or below, the reference value, the process of (4) is repeated so that the suspension is made thicker. As an example, the reference value for the degree of concentration of the suspension is about 20 wt%. If the degree of concentration of the suspension is low, a problem occurs, since too much water is added when a required amount of the active clay that is contained in the suspension is added to the green sand.

(5) A suspension that has a degree of concentration over the reference value is stored in the storage tank 3 (the step of storing). The storage tank 3 is preferably equipped with a stirring device to prevent settling.

(6) The suspension in the storage tank is fed to an apparatus 6 for kneading the green sand by a fixed amount by means of a volumetric feeder 4 (the step of feeding) when the green sand is kneaded. The volumetric feeder 4 may be a slurry pump. The active clay that is contained in the suspension is reused through the steps (1) to (6). In this way about 50% of the active clay that is to be supplied can be saved.

(7) The residual particles of the sand that have been generated in the process to separate the suspension from the residual particles of the sand are reclaimed by removing the Oolitic layer by means of the system 7 for mechanically reclaiming the green sand (the step of removing the layer). The Oolitic layer that strongly adheres to the surfaces of the residual particles of the sand can be removed by the system 7 for mechanically reclaiming the green sand. This system 7 preferably performs a drying process. It may be any known system. For example, a system for applying force from friction to the sand may be used, wherein the residual particles of the sand are supplied to a cup-like rotor that rotates and wherein blades are provided above the wall of the rotor. When the rotor rotates, the residual particles of the sand scrub each other or collide with the blades so that the Oolitic layer is cracked and stripped from the surfaces of the particles of the sand. Incidentally, the Oolitic layer is a layer of fine powder that has low resistance to heat. This layer is strongly burned on the surfaces of the particles of the sand. The reclaimed sand can be reused as core sand, etc.

Working Example

[0024] The degrees of separating active clay from the green sand by means of ultrasonic waves and by means of mechanical agitation are tested for comparison. The results are shown in Fig. 2. The results were evaluated by The Method for Evaluating Active Clay (TJFS-205), issued by Tokai Branch, Japan Foundry Engineering Society. The content of the active clay is measured as be-

low. 50 cm³ of a 2% solution of sodium pyrophosphate is added to 5 g of green sand, and then is subjected to ultrasonic washing for 10 minutes. The sodium pyrophosphate has abilities to strip the coating materials on the surfaces of the particles of the sand and to disperse them. The supernatant liquid is titrated by a methylene blue solution of 1/100 concentration. The content of the active clay is determined by the consumption of the solution.

[0025] By this method, sodium pyrophosphate, which has a function for causing a dispersion, is added. However, in the present invention no dispersing agent is added. Thus distilled water, which contains no dispersing agent, is used to compare possible collections of the active clay by means of ultrasonic waves and by means of mechanical agitation.

[0026] The green sand is subjected to the ultrasonic treatment by using distilled water, which contains no dispersing agent, so that 74% of the active clay in the green sand is included in the suspension to be collected. Thirty-eight percent of the active clay is separated and collected by means of mechanical agitation.

[0027] From the above experiments, it is seen that 70% or more of the active clay has been collected by the ultrasonic treatment by using distilled water. This method is found to be very industrially useful.

[0028] The reference signs used in the present specification and the drawings are as follows:

- 0 the hopper for the sand that has overflowed
- 1 the ultrasonic washer
- 2 the separator
- 3 the storage tank
- 4 the volumetric feeder
- 5 the apparatus for circulating and making the suspension thicker
- 6 the apparatus for kneading the green sand
- 7 the system for mechanically reclaiming the green sand

Claims

1. A method for reusing green sand comprising the steps of:

treating the green sand with ultrasonic waves in water;
separating a mixture that is obtained by the step of treating the green sand with ultrasonic waves to form a suspension and to form residual particles of the sand;
circulating the suspension to then proceed to the step of treating the green sand with ultrasonic waves so that the suspension is concentrated;
storing the concentrated suspension; and
feeding the stored suspension to green sand by a predetermined amount when green sand is mulled.

2. The method for reusing the green sand of claim 1, further comprising:
a step of removing an Oolitic layer from the residual particles of the sand that have been separated in the step of separating. 5
3. An apparatus for reusing green sand comprising:
an ultrasonic washer for treating green sand with ultrasonic waves in water, the green sand having been used; 10
a separator for separating a mixture that is obtained by the ultrasonic washer to form a suspension and to form residual particles of the sand; 15
an apparatus for circulating and making the suspension thicker, which apparatus measures a degree of concentration of the separated suspension, which apparatus returns the suspension to the ultrasonic washer if the degree of concentration that is measured equals, or is below, a predetermined degree of concentration, and which apparatus feeds the suspension to a storage tank for storing the suspension if the degree of concentration that is measured is over the predetermined degree of concentration; 20
the storage tank that stores the suspension of which the degree of concentration is over the predetermined degree of concentration; and 25
a volumetric feeder that feeds the stored suspension by a predetermined amount when the green sand is mulled. 30
4. The apparatus for reusing the green sand of claim 3, further comprising: 35
a system for mechanically reclaiming the green sand that removes an Oolitic layer from the residual particles of the sand that have been separated in the separator. 40

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Fig. 1

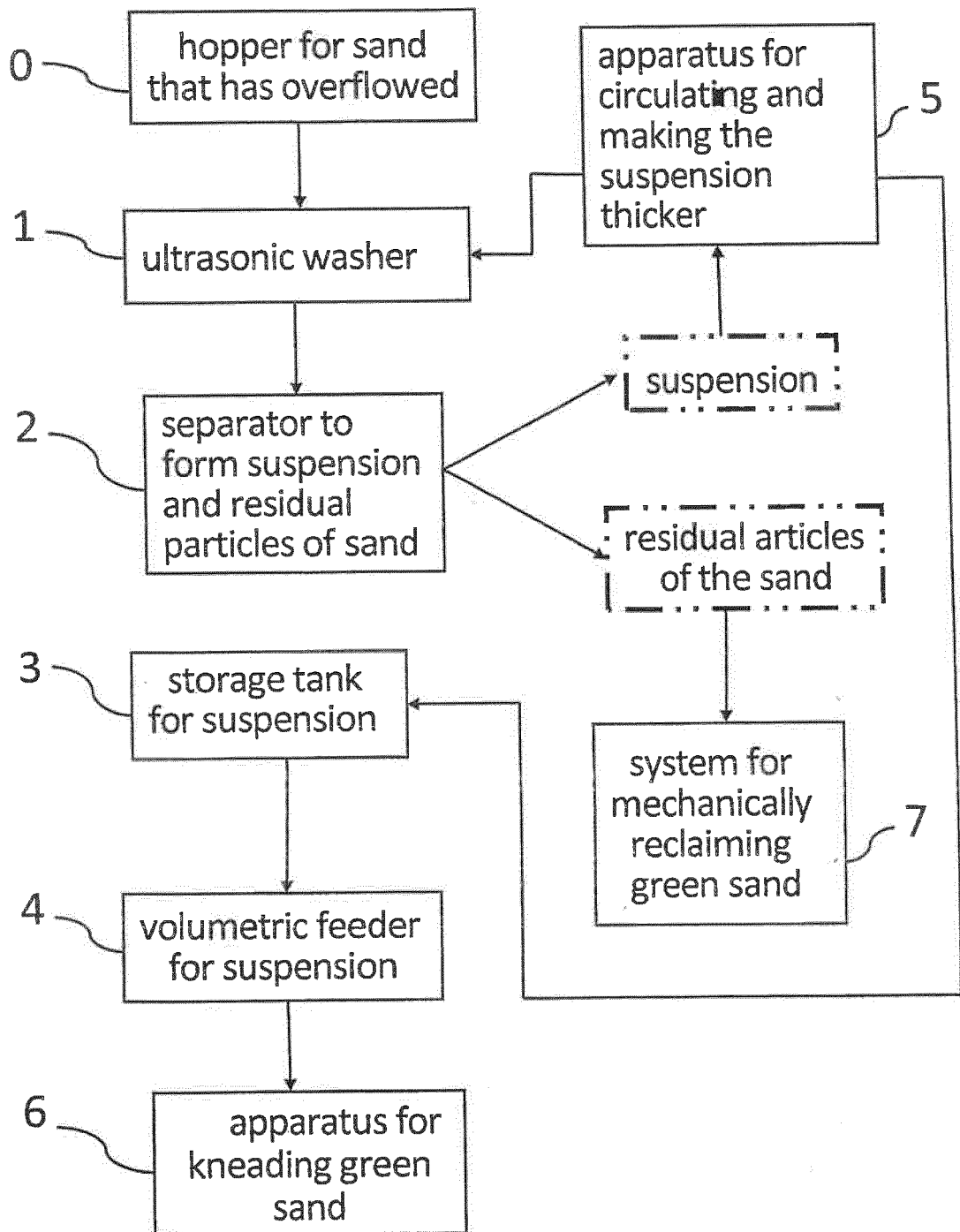
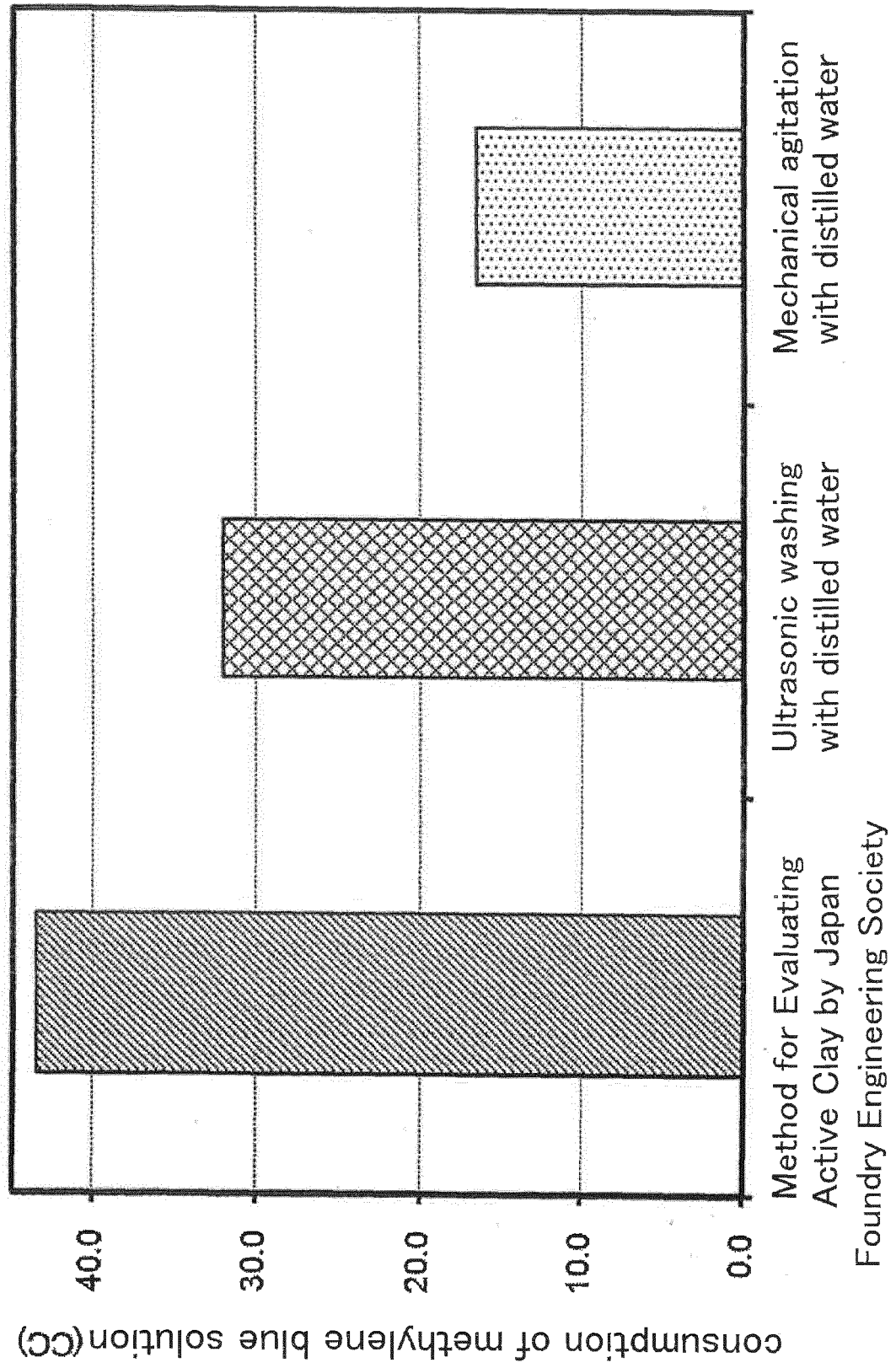


Fig. 2



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/002613

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. B22C5/00 (2006.01) i, B22C5/14 (2006.01) i

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)

Int. Cl. B22C5/00, B22C5/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2018

Registered utility model specifications of Japan 1996-2018

Published registered utility model applications of Japan 1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2012/0000997 A1 (HYUNDAI MOTOR COMPANY) 05 January 2012, paragraphs [0003], [0013], [0014], [0048], [0049], [0062]-[0066], fig. 3, 4 & KR 10-2012-001933 A	1-4
Y	JP 2005-138141 A (TOYOTA MOTOR CORP.) 02 June 2005, claim 1, paragraphs [0001], [0031]-[0033], fig. 1 (Family: none)	1-4



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&"

document member of the same patent family

Date of the actual completion of the international search

25.04.2018

Date of mailing of the international search report

15.05.2018

Name and mailing address of the ISA/
Japan Patent Office
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Tokyo 100-8915, Japan

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Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/002613

C (Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2004-532129 A (FOUNDRY ADVANCED CLAY TECHNOLOGIES, LLC) 21 October 2004, claims 1, 7, paragraphs [0001], [0012], [0013], [0024] & WO 022/092259 A2, page 1, lines 5-7, page 3, line 24 to page 4, line 25, page 7, lines 19-29 & US 2003-0029592 A1 & EP 1387729 A1 & CA 2450347 A	1-4
Y	黒川豊, オーリチックの付着した生型廃砂の再生, 鋳造工学, July 1999, vol. 71, no. 7, pp. 468-474, in particular, fig. 1 (KUROKAWA, Yutaka et al. Reclamation Mechanism of Waste Green Sand Adhered with Oolitics. Journal of Japan Foundry Engineering Society)	2, 4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003290872 A [0008]
- JP 2004532129 PCT [0008]
- JP 2017120202 A [0018]