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(71) Applicant: **INAX CORPORATION**
3-6, Koiehonmachi
Tokoname-Shi Aichi (JP)

(72) Inventor: **Senda, Kazuo**
c/o Inax Co., 3-6 Koiehonmachi
Tokonama-Shi, Aichi (JP)

(74) Representative: **Cockbain, Julian et al**
Frank B. Dehn & Co. Imperial House 15-19,
Kingsway
London WC2B 6UZ (GB)

(54) **Sludge-discharging cast molding method.**

(57) A sludge-discharging cast molding method comprising charging a water absorbing molding die with sludge, permitting sludge to deposit therein to form a deposition product, discharging excess undeposited sludge from said die, and introducing steam into said molding die to heat the deposition product.

In this way water absorption from the deposition product is accelerated so allowing the cycling time for the operation of the die to be reduced.

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The present invention relates to a sludge-discharging cast molding method, and in particular to a sludge-discharging cast molding method capable of substantially reducing the molding time.

A sludge-discharging cast molding method comprises charging an absorbing molding die, for example made of gypsum, with a sludge (slurried granular raw clay), allowing the water contained in the sludge to penetrate into the molding die thereby depositing the remaining granular raw clay onto the inner surface of the molding die, thereafter discharging any excess sludge, opening the molding die after a predetermined period of time has elapsed and removing the deposited product. This molding method is employed generally as a method of manufacturing various kinds of sanitary potteries and the like.

However, the conventional method described above has a problem in that the water content of the deposition product does not transfer into the molding die until a considerable period of time has passed following discharge of the excess sludge. Thus each molding cycle takes a long time.

Accordingly, an object of the present invention is to provide a sludge-discharging cast molding method capable of substantially reducing the standing time following discharge of the excess sludge and, accordingly, capable of reducing the molding time thereby increasing the cycling rate of the molding operation using the molding die and improving production efficiency.

Thus viewed from one aspect the invention provides a sludge-discharging cast molding method comprising charging a water absorbing molding die with sludge, permitting sludge to deposit therein to form a deposition product, discharging excess undeposited sludge from said die, and introducing steam into said molding die to heat the deposition product. After steam is introduced into the die and the deposition product is thereby heated the die is preferably flushed with air or another substantially dry gas. Thereafter the die may be released (opened) and the molding product taken out.

When the deposition product is heated following discharge of the excess sludge, the viscosity of the water in the deposition product is lowered, thereby increasing the rate of transfer of water from the deposition product into the molding die. This enables the mold to be released within a shorter period of time following discharge of the excess sludge.

Viewed from a further aspect the invention also provides a molding die having a water absorbing inner surface, means for receiving an aqueous slurry and means for discharging excess slurry, said die also being provided with steam inlet means arranged to permit flow of steam over the surface of a deposition product formed on a said water absorbing surface.

The molding die used in the present invention may be gypsum, but a die made of a porous synthetic resin having water absorbing property may also be used. The molding die can be used for various kinds of sanitary pottery such as western toilets, Japanese toilets and washing basins, as well as for various other kinds of pottery.

The sludge charged into the molding die may be of the type conventionally used.

In the case of the manufacture of a washing basin, sludge is injected and then deposited for about 10 to 80 min., preferably, 15 to 60 min and then discharged. After discharging the sludge, steam is introduced into a molding space of the molding die (the space previously occupied by the excess sludge) to heat the deposition product.

It is apparent from the results of the experiments described below that the water contained in the deposition product is absorbed faster into the molding die as the introduction time of the steam is increased. However, if the absorption occurs too rapidly, cracks may result in the final molding product. In view of the above, after introducing the steam into the molding die, this state is maintained, preferably, for about 30 sec to 3 min., more preferably for about 40 sec to 100 sec and, subsequently, air at ambient temperature is introduced into the molding die to discharge the steam.

Following the introduction of air into the molding die, this state is maintained for about 10 to 30 min., thereby causing the water content in the deposition product to be absorbed into the molding die. After maintaining this state till the deposition product attains a predetermined strength, the mold is released to take out the molding product.

The molding product may then be finished into a pottery product using the steps of drying, glazing and baking.

Preferred embodiments of the invention will now be described by way of example and with reference to the accompanying drawings in which:

Fig. 1 is a cross sectional view of the die of Example 1;

Fig. 2 is a perspective view of the die of Example 1;

Fig. 3 is a bottom view of the washing basin of Example 2;

Fig. 4 is a plan view of the washing basin of Example 2; and

Figs. 5, 6 and 7 are graphs illustrating the results of the experiments of Example 3.

Example 1

A western toilet was molded by the sludge-discharging cast molding method of the invention using a gypsum die 1 as shown in Fig. 1.

At first, sludge (concentration of starting clay at 1250 g/l) at a temperature of 30°C was charged into the gypsum die and then allowed to deposit for 100 min. The excess sludge was then discharged and steam at a pressure of 0.2 kg/cm^2 was introduced into the gypsum die 1 and this state was maintained for 50 sec in order to heat the deposition product. Then, air at ambient temperature was introduced and, after maintaining this state for 20 min. the molding die was released. A molding product, in the form of a western toilet, having a required molding strength was obtained.

Comparative Example 1

A molding product was manufactured analogously to Example 1 except that no steam or air was introduced into the molding die after discharging the excess sludge. However, it was necessary to allow the deposition product to stand for about 40 min after discharging the excess sludge in order to obtain a molding product having a molding strength capable of allowing the mold to be released.

It is apparent from a comparison of Example 1 and Comparative Example 1, that the standing time (for water absorption) after discharging the excess sludge can be reduced to one half according to the method of the present invention.

Examples 2, 3 and Comparative Example 2

A hand wash basin was molded by a sludge-discharging cast molding method using the gypsum die 2 as shown in Fig. 2.

Fig. 2 illustrates an introduction hole 3 for air and steam, sludge discharging holes 4, a casting hole 5 and temperature measuring holes A and B (temperature sensor insertion holes).

The clay starting content of the sludge used was 1250 g/l and the temperature was 34°C.

The sludge was introduced into the gypsum die 2, left to deposit for the time shown in Table 1, and then discharged. Subsequently, steam at a pressure of 0.2 kg/cm^2 was introduced for 12 min in Example 2 and for 6 min in Example 3. Then the steam was discharged and, air at ambient temperature was introduced and the die was left in this state for 35 min in Example 2 and 40 min in Example 3. Thereafter the molding products were released from the molds.

In Comparative Example 2, air at ambient temperature was introduced into the gypsum die 2 following discharge of the excess sludge and the die was maintained in this state for 35 min. Thereafter the molding product was released from the mold.

Table 1

No.	Deposition Time	Steam introduction time	Post-air Introduction standing time
Example 2	40 mins	12 mins	35 mins
Example 3	50 mins	6 mins	40 mins
Comparative Example 2	40 mins	0 min	35 mins

For the molding products so obtained, the hardness was measured using a rubber hardness gauge at positions a to 1 as shown in Fig. 3 (bottom view for a washing basin 6) and Fig. 4 (plan view thereof). The results are shown in Table 2. Of the positions a to 1, k and 1 indicate positions at the inner surface of a side (a side wall) of the washing basin, and j indicates a position at the back of an overflow port 7.

Table 2 also shows the weight of the deposition product (molding product) and the water content therein.

It is apparent from Table 2 that the water content in the molding product is reduced and the hardness is substantially increased by the method according to the present invention, as compared with the comparative examples.

Table 2

Item		Example 2	Example 3	Comparative Example 2
Result of Hardness Measurement	a	63	65	70
	b	88	86	63
	c	88	85	60
	d	88	84	53
	e	84	84	40
	f	83	81	42
	g	86	82	36
	h	45	75	41
	i	43	53	45
	j	55	59	58
	k	85	77	67
	l	77	76	63
Deposition weight (kg)		7.18	7.58	7.68
Water content (%)		18.52	18.73	19.79

In Example 3, the change of temperature with time in the gypsum die 2 was measured following the introduction of the steam. The results are shown in Fig. 5. It can be seen that the die temperature is elevated by the introduction of the steam.

In Example 3, molding was conducted whilst varying the steam introduction time from 0 to 12 min and the hardness and water content of the resultant molding products were measured. The results are shown in Figs. 6 and 7.

It is apparent from Figs. 6 and 7, that the hardness of the molding product increases and the water content in the molding product decreases with a corresponding increase in the steam introduction time.

As apparent from the foregoing Examples, the standing time after discharging the excess sludge can be substantially reduced by the method according to the present invention. Therefore, it is possible to shorten the molding time and increase the number of operation cycles of the molding die within a given time to improve the production efficiency.

Claims

1. A sludge-discharging cast molding method comprising charging a water absorbing molding die with sludge, permitting sludge to deposit therein to form a deposition product, discharging excess undeposited sludge from said die, and introducing steam into said molding die to heat the deposition product.

2. A method as claimed in claim 1 wherein following the introduction of steam the die is flushed with air.

3. A method as claimed in either of claims 1 and 2, wherein the die is subsequently released and the molding

product removed.

4. A method as claimed in any one of claims 1 to 3, wherein said molding die is a gypsum die.

5. A method as claimed in any one of claims 1 to 4, wherein the deposition product is maintained in contact with the introduced steam for a predetermined period of time whereafter air at ambient temperature is introduced to discharge the steam.

6. A method as claimed in claim 5, wherein said predetermined time is in the range 30 seconds to 3 minutes.

7. A method as claimed in either of claims 5 and 6, wherein the molding die is released 10 to 30 minutes after said introduction of air.

8. A method as claimed in any one of the preceding claims, wherein said molding die is charged with sludge and said excess sludge is discharged 10 to 80 minutes thereafter.

9. A molding product produced by a method as claimed in any preceding claim.

10. A molding die (2) having a water absorbing inner surface, means for receiving an aqueous slurry (5) and means for discharging excess slurry (4), said die also being provided with steam inlet means (3) arranged to permit flow of steam over the surface of a deposition product formed on a said water absorbing surface.

FIG.1

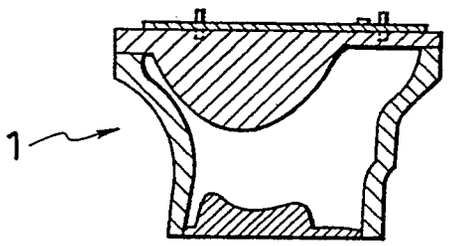


FIG.2

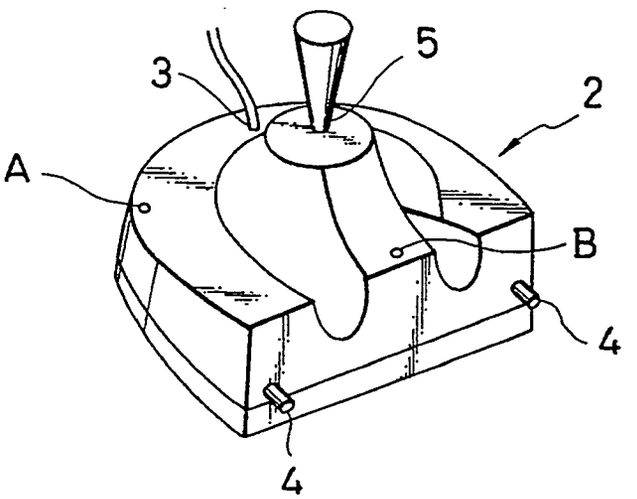


FIG.3

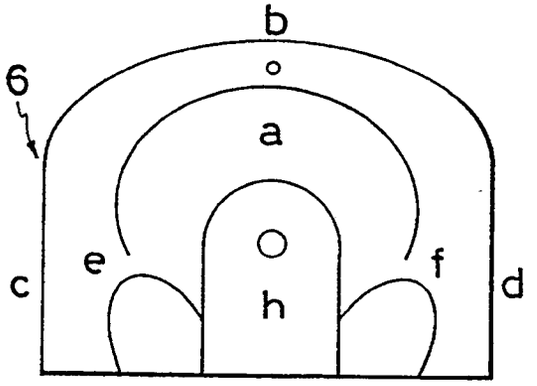


FIG.4

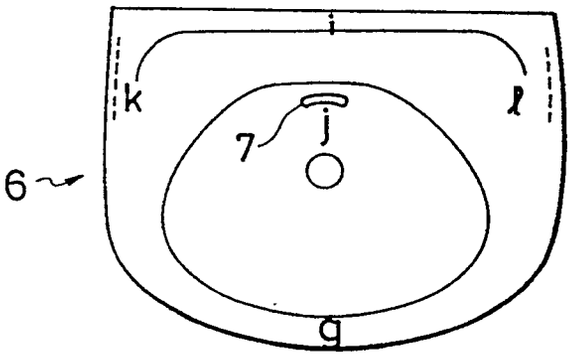


FIG.5

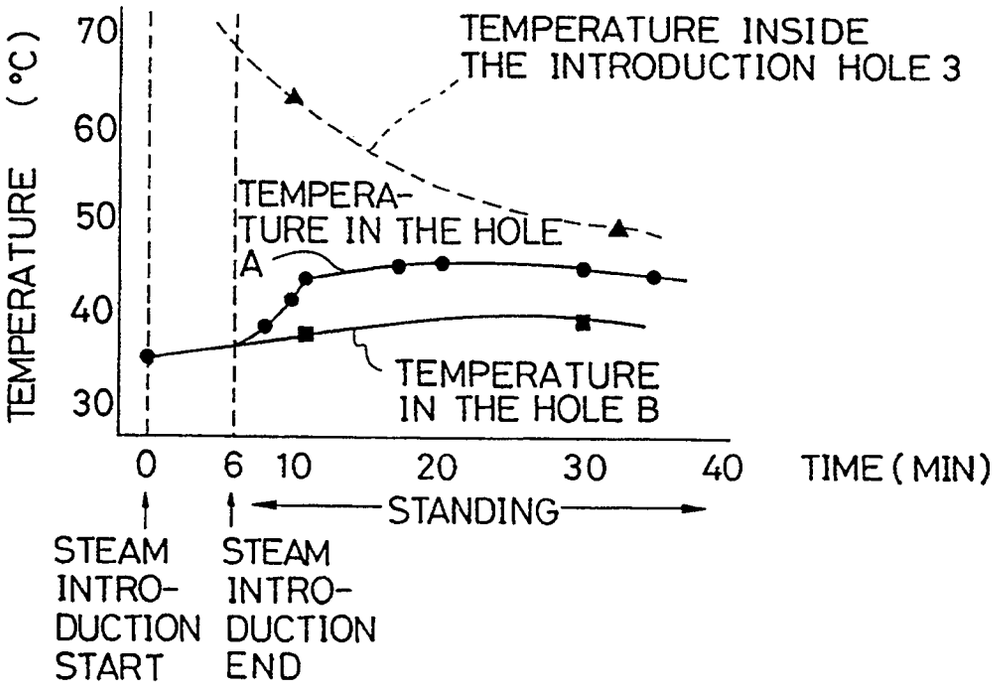


FIG.6

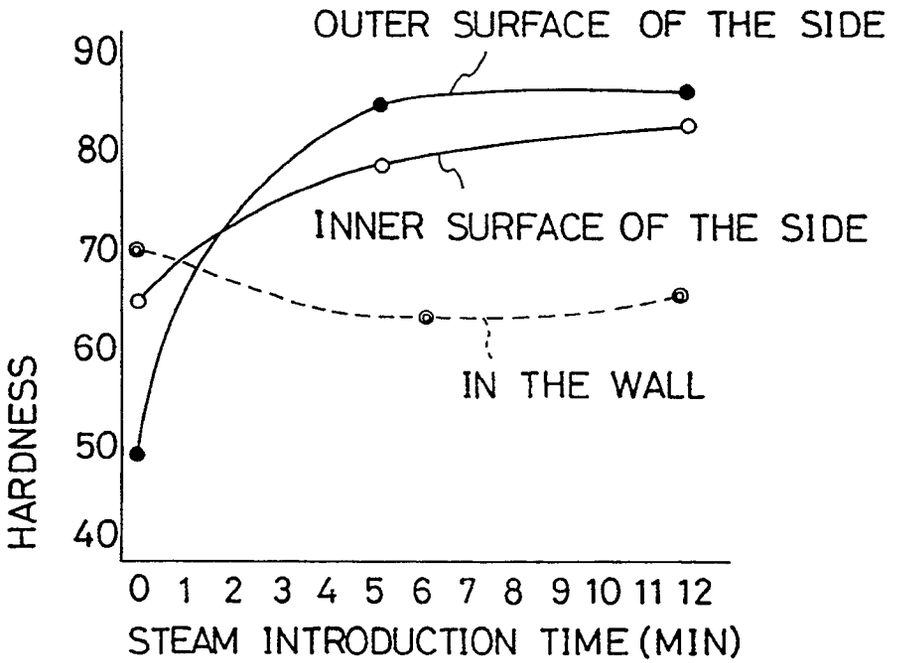
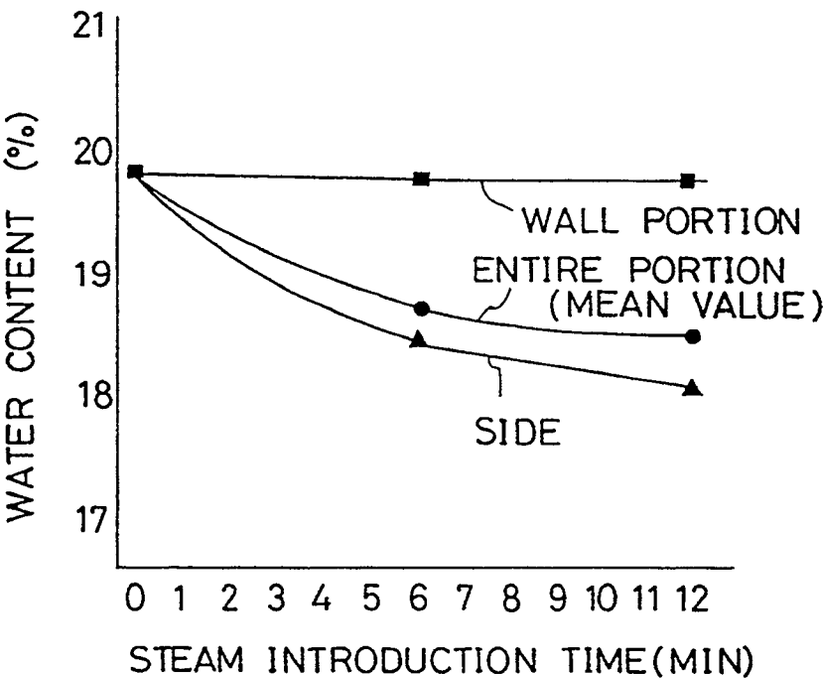

OUTER SURFACE OF THE SIDE
INNER SURFACE OF THE SIDE
IN THE WALL
HARDNESS
90
80
70
60
50
40
0 1 2 3 4 5 6 7 8 9 10 11 12
STEAM INTRODUCTION TIME (MIN)

FIG.7


WATER CONTENT (%)
21
20
19
18
17
WALL PORTION
ENTIRE PORTION
(MEAN VALUE)
SIDE
0 1 2 3 4 5 6 7 8 9 10 11 12
STEAM INTRODUCTION TIME(MIN)