

TITLE OF THE INVENTION

METHOD FOR MANUFACTURING EXTRUSION MOLDING

Technical Field

5 [0001]

The present invention relates to a method for manufacturing an extrusion molded product.

Background Art

10 [0002]

Generally, catalysts, catalyst carriers, adsorbents, desiccants, moisture absorbents, and the like are molded into columnar or cylindrical shape with a diameter of 2~10 mm and a length of 2~20 mm, and then such molded products are filled into a column or reactor to be used in chemical procedures that entail various unit operations such as absorption processes and chemical reactions. To manufacture those molded products of fillers and catalysts, extrusion-molding methods have been employed.

[0003]

Patent Literature 1 proposes a method for manufacturing a catalyst for producing methacrylic acid, characterized by a primary molding step for molding a kneaded product and a secondary molding step for using a piston extruder to mold the primary molded product into a final shape. In such a method, the secondary molding pressure (P2) relative to the primary molding pressure (P1) is set in a range of (P1-0.2) MPaG to (P1-8) MPaG.

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PRIOR ART LITERATURE

PATENT LITERATURE

[0004]

Patent Literature 1: JP2011-224482A

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SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0005]

Currently in demand for industrial applications are manufacturing methods for extrusion molded products that can reduce unevenness of quality of the molded products by using more simplified procedures than those in conventional methods.

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[0006]

For example, when fillers are packed into columns with a fixed volume or size, or when catalysts are packed into reaction tubes with a fixed volume or size, it is necessary to pack a filler or catalyst at a predetermined amount. Especially, when a multi-tubular heat-exchanger-type reactor is used, it is required to pack multiple reaction tubes with the same amount of catalyst. Considering such requirements, it is an important factor to achieve uniform packing density when a filler or catalyst is packed.

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[0007]

The objective of the present invention is to provide a manufacturing method for extrusion molded products that is capable of reducing unevenness of the quality of extrusion molded products by using simplified procedures.

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MEANS FOR SOLVING PROBLEMS

[0008]

A method for manufacturing an extrusion molded product according to an embodiment of the present invention has the following steps:

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(1) a step for manufacturing a kneaded product by kneading a starting material powder, a liquid and a binder;

(2) a step for manufacturing a crushed product by crushing the kneaded product; and

(3) a step for molding the crushed product by using an extruder.

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In such a method, the crushed product in step (2) is crushed to a particle size such that 80 mass% or more passes through a sieve of nominal dimension (D/2) mm when the internal cylinder diameter of the extruder in step (3) is D mm,.

[0009]

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A method for manufacturing an extrusion molded product according to another embodiment of the present invention has the following steps:

(1) a step for manufacturing a kneaded product by kneading a starting material powder, a liquid and a binder;

(2) a step for manufacturing a crushed product by crushing the kneaded product; and

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(3) a step for molding the crushed product by using an extruder.

In step (2) of such a method, the kneaded product is crushed using a crusher.

EFFECTS OF THE INVENTION

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[0010]

According to the embodiments of the present invention, methods for manufacturing an extrusion molded products are provided so that extrusion molded products with minimal unevenness of quality are obtained using simplified procedures.

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MODE FOR CARRYING OUT THE INVENTION

[0011]

Examples of starting material powder used in production methods related to the present invention are a powdered catalyst and its precursor powder for producing methacrylic acid by subjecting methacrolein to gas-phase catalytic oxidation [described in Patent Literature 1 (JP2011-224482A)].

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[0012]

According to the embodiments of the present invention, an extrusion molded product is manufactured by employing step (1) for manufacturing a kneaded product by kneading a starting material powder, a liquid and a binder; step (2) for manufacturing a

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crushed product by crushing the kneaded product; and step (3) for molding the crushed product by using an extruder. Usually, an extrusion molded product is manufactured by further employing step (4) for drying the molded product obtained in step (3).

5 [0013]
(Step (1))

In step (1), a starting material powder, a liquid and a binder are kneaded. The apparatus used for kneading is not limited specifically; for example, batch-type kneaders with double-arm sigma blades, continuous kneaders with reciprocating rotary
10 shafts, continuous kneaders with self-cleaning functions, and the like. However, batch-type kneaders are preferred because the condition of the kneaded product can be checked while kneading is under way. Also, when to finish kneading is usually determined by visual inspection or by touch.

15 [0014]

The liquid used in step (1) is not limited specifically, as long as it is capable of wetting the starting material powder; examples are water, and alcohols having 1~4 carbon atoms such as methyl alcohol, ethyl alcohol, propyl alcohol and butyl alcohol. They may be used alone or in combination thereof. Among those listed above, water
20 or ethyl alcohol is preferred because of the ease of handling. In the embodiments of the present invention, a liquid indicates a compound that is in a liquid state under conditions of normal temperature and normal pressure (25°C, 0.101 MPa).

[0015]

25 The amount of liquid used in step (1) is selected appropriately according to the type and particle size of the starting material powder and the type of liquid, and is preferred to be 10~80 parts by mass relative to 100 parts by mass of starting material powder to be kneaded with it.

30 [0016]

A liquid amount of at least 10 parts by mass allows smooth extrusion-molding, and uniformly shaped molded products are achieved. On the other hand, a liquid amount of no greater than 80 parts by mass reduces adhesiveness during the molding process, and ease of handling is thereby enhanced. Relative to 100 parts by mass of starting
35 material powder, the amount of liquid is more preferred to be 5~50 parts by mass, even more preferably 10~45 parts by mass, and especially preferably 15~40 parts by mass.

[0017]

40 The binder used in step (1) is not limited specifically as long as it is capable of binding the starting material powder; examples of organic binders are polymer compounds such as polyvinyl alcohols, α -glucan derivatives, β -glucan derivatives and the like. They may be used alone or in combination thereof.

[0018]

45 In the embodiments of the present invention, α -glucan derivatives are

polysaccharides linked by α glucosidic bonds that are constituted from glucose; for example, α 1-4 glucans, α 1-6 glucans, α 1-4/1-6 glucans, and the like. Examples of such α -glucan derivatives are amylose, glycogen, amylopectin, pullulan, dextrin, cyclodextrin and the like. They may be used alone or in combination thereof.

[0019]

In the embodiments of the present invention, β -glucan derivatives are polysaccharides linked by β glucosidic bonds that are constituted from glucose; for example, β 1-4 glucans, β 1-3 glucans, β 1-6 glucans, β 1-3/1-6 glucans and the like.

Examples of such β -glucan derivatives are cellulose derivatives such as methyl cellulose, ethyl cellulose, carboxymethyl cellulose, sodium carboxymethyl cellulose, hydroxyethyl cellulose, hydroxypropyl cellulose, hydroxypropyl methyl cellulose, hydroxyethyl methyl cellulose, hydroxybutyl methyl cellulose, ethylhydroxyethyl cellulose, and hydroxypropyl cellulose; β 1-3 glucans such as curdlan, laminarin, paramylon, callose, pachyman, and scleroglucan. They may be used alone or in combination thereof.

[0020]

The organic binder may be a purified or unpurified type. However, to prevent impurities such as metal impurities and ignition residues from causing a decrease in catalytic activity, the smaller the amount of metal impurities and ignition residues in the binder, the more preferable it is.

[0021]

Examples of inorganic binders are those conventionally known inorganic compounds such as silica, alumina, silica-alumina, silicon carbide, titania, magnesia, graphite, and diatomaceous earth; and inert carriers, for example, ceramic balls, stainless steel, and inorganic fibers such as glass fiber, ceramic fiber, and carbon fiber. They may be used alone or in combination thereof. In addition, a combination of organic and inorganic binders may also be used.

[0022]

The method for mixing the above-listed starting material powder, liquid and binder is not limited specifically. In particular, a starting material powder and binder are mixed through dry blending and a liquid is added to the mixture; a binder is dissolved or dispersed in a liquid, into which a starting material powder is mixed; and so forth. It is preferred to use a method for dry blending a starting material powder and binder and then adding a liquid to the mixture. If a binder already dissolved or dispersed in a liquid is used, the amount of liquid further added when it is mixed with a starting material powder is adjusted according to the amount of liquid already contained in the binder mixture.

[0023]

The amount of binder used in step (1) is selected appropriately according to the type and size of the starting material powder and the type of liquid. Relative to 100 parts by mass of starting material powder, the amount of binder usually used is 0.05~15

parts by mass, preferably 0.1~10 parts by mass.

[0024]

The processing capacity of a kneading machine used in step (1), namely, the capacity of a kneader, is not limited specifically. However, the total value obtained based on the maximum processing capacity of each kneader is preferred to be greater than the maximum processing capacity of an extruder used in step (3). When the total value obtained based on the maximum processing capacity of each kneader is greater than the maximum processing capacity of an extruder, it is easier to prevent standby time from occurring while raw material is supplied to the extruder used in step (3). Therefore, unevenness of the fluidity of material remaining in the extruder is prevented so as not to cause a difference in fluidity from that of the newly supplied material when standby time occurs. To achieve such effects, it is preferred to continuously supply raw material if it is a continuous extruder, and to supply raw material without resulting in standby time if it is a batch extruder. Thus, the maximum processing capacity of a machine used in step (1) is preferred to be greater than that of a machine used in step (3).

[0025]

Here, the maximum processing capacity of a machine means the maximum processing amount [kg] per unit time [h] when a target product is processed by the machine and when the result satisfies the quality specified in that step.

[0026]

(Step (2))

In step (2), the kneaded product obtained in step (1) is crushed.

[0027]

In the embodiments of the present invention, to crush means to break lumps into pieces with a smaller particle size than the initial size.

[0028]

The crushing method is not limited specifically; for example, lumps may be broken by hand, or by using a crusher, lump breaker or the like. Among those, it is preferred to use a crusher because lumps are crushed into pieces with a desired particle size in a shorter period of time.

[0029]

Crushers that employ shearing, impact and cutting forces may be used. For example, tumbling mill types, screw types, auger types and the like are preferred. Specific examples are a scraping type bale breaker with doffing rollers and declumper, twin-shaft breaker, single-shaft breaker, and screw-auger type breaker, made by Ohara Corporation; a screw-auger type pulverizer made by Kobelco Construction Machinery; single-shaft pulverizer made by Aishin Industrial Corporation; a Roundel Mill grinder made by Tokuju Corporation; and so forth.

[0030]

In the embodiments of the present invention, the crushed product in step (2) is crushed so that when the internal cylinder diameter of the extruder used in step (3) is D mm, 80 mass% or more of the crushed product passes through a sieve of nominal dimension (D/2) mm. When at least 80 mass% of the crushed product is set to pass through a sieve of nominal dimension (D/2) mm, air inclusion is suppressed in moldings when the crushed product is extrusion-molded. Thus, it is easier to decrease unevenness of the quality of extrusion molded products. The percentage of crushed product passing through a sieve of nominal dimension (D/2) mm is preferred to be 85 mass% or greater, more preferably 90 mass% or greater. In the present application, a nominal dimension indicates the length of a side of sieve mesh (also referred to as an aperture).

[0031]

When a crusher is used in step (2), its processing capacity is not limited specifically; however, the total value obtained based on the maximum processing capacity of each crusher is preferred to be greater than the maximum processing capacity of an extruder used in step (3). When the total value obtained based on the maximum processing capacity of each crusher is greater than the maximum processing capacity of an extruder used in step (3), it is easier to prevent standby time from occurring while raw material is supplied to the extruder. Therefore, unevenness of the fluidity of material remaining in the extruder is prevented so as not to cause a difference in fluidity from that of the newly supplied material when standby time occurs. Accordingly, the total value obtained based on the maximum processing capacity of each crusher used in step (2) is preferred to be greater than the maximum processing capacity of an extruder used in step (3). Also, it is preferred to continuously supply raw material if it is a continuous extruder, and to supply raw material without resulting in standby time if it is a batch extruder.

[0032]

When a crusher is used in step (2), the power of the crusher is not limited specifically but the power relative to the volume of the crusher is preferred to be $10 \text{ kW/m}^3 \sim 500 \text{ kW/m}^3$, more preferably $50 \text{ kW/m}^3 \sim 400 \text{ kW/m}^3$. When the power relative to the volume of a crusher is set at 10 kW/m^3 or greater, it is easier to achieve excellent crushing results of the kneaded product obtained in step (1). In the embodiments of the present invention, the volume of a crusher does not include the volume of pipes in the area for supplying and discharging raw material, but includes only the volume of the crusher itself that crushes raw material. The power of a crusher is that of a motor used for crushing.

[0033]

(Step (3))

In step (3), the crushed product obtained in step (2) is extrusion-molded to manufacture extrusion molded products. Auger extruders, plunger extruders and the

like, for example, are used for extrusion molding. Among them, plunger extruders are preferred since they are capable of supplementing the kneaded product with excellent kneading, and the molded catalyst shows less unevenness in its properties. The shape of extrusion molded products is not limited specifically, and any shape, for example, annular, columnar, star-shaped or the like, may be employed. The internal cylinder diameter (D) of the extruder is preferred to be 10 mm~600 mm, more preferably 20 mm~400 mm, even more preferably 30 mm~300 mm. When the cylinder length is set L mm, the ratio (L/D) is preferred to be 1~20, more preferably 1.1~10.

[0034]

It is an option to connect a crusher and an extruder used respectively in steps (2) and (3) so that procedures from crushing to molding are continuously carried out.

[0035]

(Step (4))

In Step (4), the extrusion molding obtained in step (3) is dried. The drying method is not limited specifically; generally known methods are hot air blowing, moisture reduction, drying using far infrared rays or microwaves, and the like. Drying conditions may be employed appropriately to achieve a desired moisture content.

[0036]

(About Catalyst)

The starting material powder may be a powdered catalyst or its precursor powder that contains at least molybdenum and phosphorus as catalytic components and is used for producing unsaturated carboxylic acid through gas-phase catalytic oxidation of unsaturated aldehyde using molecular oxygen.

[0037]

In the above, an extrusion molded product of a catalyst is manufactured by using the method related to the present invention, and the extrusion molded product is thermally treated so as to obtain a catalyst for producing unsaturated carboxylic acid. Especially, if unsaturated carboxylic acid is (meth)acrylic acid, a catalyst for producing (meth)acrylic acid is obtained, the catalyst is then used to produce (meth)acrylic acid through gas-phase catalytic oxidation of (meth)acrolein using molecular oxygen.

[0038]

In addition, the starting material powder may be a powdered catalyst or its precursor powder that contains at least molybdenum and bismuth as catalytic components and is used when gas-phase catalytic oxidation is carried out on propylene, isobutylene, primary butyl alcohol, tertiary butyl alcohol or methyl tert-butyl ether using molecular oxygen so as to produce their respectively corresponding unsaturated aldehyde and unsaturated carboxylic acid.

[0039]

In the above, an extrusion molded product of a catalyst is manufactured by using

the method related to the present invention, and the extrusion molded product is thermally treated to obtain a catalyst for producing unsaturated aldehyde and unsaturated carboxylic acid. Especially, if unsaturated aldehyde is (meth)acrolein and if unsaturated carboxylic acid is (meth)acrylic acid, a catalyst for producing (meth)acrolein and (meth)acrylic acid is obtained, and the catalyst is then used for gas-phase catalytic oxidation of propylene, isobutylene, primary butyl alcohol, tertiary butyl alcohol or methyl tert-butyl ether using molecular oxygen to produce (meth)acrolein and (meth)acrylic acid.

10 [0040]

In a process for manufacturing a catalyst, it is preferred to calcine the extrusion molded product. However, such a calcination process may be omitted if the catalyst has been calcined before extrusion-molding. When not calcined, a catalyst is obtained after a molded product is dried, and when thermally treated, a catalyst is obtained as a thermally treated product. The calcination method is not limited specifically, and a method and conditions for calcination may be selected appropriately. Calcination conditions differ depending on the compound used as a raw material, the composition of catalytic components, and the preparation method of the catalyst. Preferred conditions are set at 200~600°C for at least 0.5 hours under the flow of inert gas or oxygen-containing gas such as air. Here, inert gas indicates a gas that does not decrease reaction activity of the catalyst, for example, nitrogen, carbon dioxide, helium, argon or the like. An extrusion molded product may be calcined in a heating device, or it may be packed in a reactor and heated therein.

25 [0041]

In the embodiments of the present invention, “thermal treatment” includes applying heat for a drying process and/or applying heat for a calcination process. A catalyst may be obtained when an extrusion molded product is dried by applying heat (without calcination), or when an extrusion molded product is heated to dry it while calcining it.

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EXAMPLES

[0042]

In the following, the present invention is described in detail with reference to examples and comparative examples. However, the present invention is not limited to those examples.

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[0043]

During a crushing process conducted by hand in each example and comparative example, a kneaded product was collected into a plastic bag, and clay-like lumps were broken into pieces by hand.

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[0044]

For sifting the kneaded product in each example and comparative example, a sieve of nominal dimension (D/2) mm was horizontally oscillated by hand, and the kneaded product was put into the sieve at such a speed that the newly added kneaded product

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would not overlap the old one on the sieve.

[0045]

Unevenness of the quality of extrusion molded products was evaluated based on a standard deviation of the packing density of 10 molded products, each of which was manufactured under the same molding conditions. A molded product was packed to a level of 100 mL of a measuring cylinder with an inner diameter of 27 mm, and its packing density was calculated from its mass (X) as follows.

10 [0046]

Packing density (g/L)= $X \times 10$

In addition, “parts” in examples and comparative examples means “parts by mass.”

[0047]

15 In a later-described evaluation of reactions, the source gas and produced articles were analyzed through gas chromatography. The reaction rate of methacrolein, selectivity of methacrylic acid and yield of methacrylic acid are defined as follows.

[0048]

20 Reaction rate of methacrolein (%)= $(B/A) \times 100$

Selectivity of methacrylic acid (%)= $(C/B) \times 100$

Yield of methacrylic acid (%)= $(C/A) \times 100$

Here, (A) is a molar number of supplied methacrolein, (B) is a molar number of reacted methacrolein, and (C) is a molar number of produced methacrylic acid.

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[0049]

[Examples 1~4, Comparative Example 1]

The following procedures were carried out for each of Examples 1~4 and Comparative Example 1.

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[0050]

In 4000 parts of pure water, 1000 parts of molybdenum trioxide, 34 parts of ammonium metavanadate, 80 parts of an 85 mass% phosphoric-acid solution and 7 parts of copper nitrate were dissolved, and the temperature of the mixture was raised to 95°C while the mixture was being stirred. Then, the mixture was stirred for 3 hours while the liquid temperature was kept at 95°C. After the mixture was cooled to 90°C, a solution prepared by dissolving 124 parts of cesium bicarbonate in 200 parts of pure water was added to the mixture and the mixture was stirred for 15 minutes using a rotary-blade stirrer. Next, a solution prepared by dissolving 92 parts of ammonium carbonate in 200 parts of pure water was added, and the mixture was further stirred for 20 minutes. A resultant slurry of the mixture containing a compound as a raw material of a catalyst was dried using a parallel-flow spray dryer under conditions of a 300°C temperature at the feeding end of the dryer and a rotary disc for spraying slurry being rotated at 18,000 rpm.

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[0051]

To 100 parts of starting material powder obtained as above, 3 parts of hydroxypropyl cellulose and 18 parts of ethyl alcohol were mixed in. The mixture was kneaded until it became clay-like by using a batch kneader equipped with double-arm sigma blades.

[0052]

Fifty parts of the kneaded product was crushed by using a single-shaft crusher or by hand, and sifted through a sieve of nominal dimension ($D/2$) mm. The method for crushing, time for crushing, nominal dimension ($D/2$) of the sieve, and percentage of the crushed product that passed through the sieve of nominal dimension ($D/2$) are shown in Table 1.

[0053]

Next, a crushed product, obtained by combining the crushed product that had passed through the sieve and the crushed product that had not passed through the sieve, was extruded through a plunger extruder, and the molding was dried at 90°C for 12 hours using a hot air blower. Accordingly, a columnar molded product of a catalyst was obtained to have an outer diameter of 5.5 mm and a length of 5.5 mm. To reduce their impact on packing density, the outer diameter and length of the molded products were all set to be 5.5 mm. The same crushed product was extrusion-molded 10 times, and the standard deviation of a packing density of each product was determined. The internal cylinder diameter (D) of the plunger extruder, ratio (L/D) of the cylinder length (L) to the internal cylinder diameter (D), and standard deviation of packing densities of molded products are shown in Table 1.

[0054]

When the maximum processing capacity of the extruder was set at 1, the maximum processing capacity of the kneader was 5.7. Also, when the maximum processing capacity of the extruder was set at 1, the maximum processing capacity of the crusher was 8.3.

[0055]

The ratio of power to volume of the crusher was 92 kW/m³.

[0056]

All the molded products were mixed together and reactions were evaluated under the following conditions.

[0057]

In a stainless-steel reactor with an outer diameter of 27.5 mm and a height of 6 m equipped with an external heating medium bath, the catalyst (molded products) was packed to have a packed length of 5 m. Next, the temperature of the external heating medium bath equipped outside the reactor was set at 370°C, and the catalyst was thermally treated for 10 hours under the flow of air. Then, the temperature of the

heating medium bath was lowered to 290°C, and gas-phase catalytic oxidation of methacrolein was conducted by using a reaction gas containing 6 vol% of methacrolein, 12 vol% of oxygen, 10 vol% of water vapor, and 72 vol% of nitrogen that passed through the catalyst layer at a gas hourly space velocity of 1200 hr⁻¹. Then, 24 hours after the initiation of reactions, the generated product was collected and analyzed through gas chromatography to obtain the reaction rate of methacrolein, selectivity of methacrylic acid, and yield of methacrylic acid. The results are shown in Table 2.

[0058]

10 [Comparative Examples 2, 3]

Catalytic molded products were obtained by employing the same procedures described in Examples 1~4 and Comparative Example 1 except that the kneaded product was supplied into a plunger extruder without being crushed beforehand. Then, the standard deviation of a packing density of each molded product was determined.

15 In addition, gas-phase catalytic oxidation reaction of methacrolein was carried out. Conditions and results are shown in Tables 1 and 2.

[0059]

Table 1

Examples & Comp. Examples	method for crushing	time for crushing	internal cylinder diameter (D) of extruder	ratio (L/D): length (L) to internal diameter (D) of cylinder	nominal dimension of sieve (D/2)	rate of crushed product that passed through sieve	standard deviation of packing density
		[min]	[mm]	[mm]	[mm]	[mass%]	[g/L]
Example 1	single-shaft crusher	5	50	6.0	25	98.2	5.5
Example 2	by hand	30	50	6.0	25	85.6	6.0
Comp. Example 1	by hand	20	50	6.0	25	70.2	12.7
Comp. Example 2	—	—	50	6.0	25	10.1	13.7
Example 3	single-shaft crusher	5	100	3.5	50	100	4.6
Example 4	by hand	20	100	3.5	50	95.3	5.4
Comp. Example 3	—	—	100	3.5	50	15.0	12.6

[0060]

Table 2

Examples & Comp. Examples	reaction rate of methacrolein (%)	selectivity of methacrylic acid (%)	yield of methacrylic acid (%)
Example 1	84.5	77.1	65.1
Example 2	84.0	77.0	64.7
Comp. Example 1	83.0	76.8	63.7
Comp. Example 2	83.1	77.0	64.0
Example 3	84.6	77.1	65.2
Example 4	84.3	77.2	65.1
Comp. Example 3	83.2	77.1	64.1

WHAT IS CLAIMED IS:

1. A method for manufacturing an extrusion molded product comprises:

(1) a step for manufacturing a kneaded product by kneading a starting material powder, a liquid and a binder;

(2) a step for manufacturing a crushed product by crushing the kneaded product; and

(3) a step for molding the crushed product by using an extruder, wherein, the crushed product in step (2) is crushed to a particle size such that 80 mass% or more passes through a sieve of nominal dimension (D/2) mm when the internal cylinder diameter of the extruder in step (3) is D mm.

2. A method for manufacturing an extrusion molded product comprises:

(1) a step for manufacturing a kneaded product by kneading a starting material powder, a liquid and a binder;

(2) a step for manufacturing a crushed product by crushing the kneaded product; and

(3) a step for molding the crushed product by using an extruder, wherein the kneaded product is crushed by using a crusher in step (2).

3. The method for manufacturing an extrusion molded product according to Claim 2, wherein the total value obtained based on the maximum processing capacity of each kneading machine used in the step (1) is greater than the maximum processing capacity of the extruder used in step (3), while the total value obtained based on the maximum processing capacity of each crusher used in step (2) is greater than the maximum processing capacity of the extruder used in step (3).

4. The method for manufacturing an extrusion molded product according to Claim 2 or 3, wherein the power relative to the volume of the crusher is $10 \text{ kW/m}^3 \sim 500 \text{ kW/m}^3$ in the step (2).

5. The method for manufacturing an extrusion molded product according to any of Claims 2~4, wherein the kneaded product is crushed in the step (2) by using a crusher selected from among a scraping type bale crusher, twin-shaft crusher, single-shaft crusher, screw-auger type crusher, and tumbling mill.

6. The method for manufacturing an extrusion molded product according to any of Claims 1~5, wherein the crushed product is molded by using a plunger extruder in the step (3).

7. The method for producing an extrusion molded product according to any of Claims 1~6, wherein the internal cylinder diameter (D) of the extruder used in the step (3) is set to be 10 mm~600 mm.

8. The method for producing an extrusion molded product according to Claim 6

or 7, wherein ratio (L/D) of the cylinder length (L) to the internal cylinder diameter (D) of the extruder used in the step (3) is set to be 1~20.

9. The method for producing an extrusion molded product according to any of Claims 1~8, wherein the starting material powder is a powdered catalyst or its precursor powder that contains at least molybdenum and phosphorus as catalytic components, and is used for producing unsaturated carboxylic acid through gas-phase catalytic oxidation of unsaturated aldehyde using molecular oxygen.

10. A method for manufacturing a catalyst for producing unsaturated carboxylic acid, comprising:
producing an extrusion molded product by the method according to Claim 9; and
applying heat on the extrusion molded product.

11. The method for manufacturing a catalyst for producing unsaturated carboxylic acid according to Claim 10, wherein unsaturated carboxylic acid is (meth)acrylic acid.

12. The method for producing an extrusion molded product according to any of Claims 1~8, wherein the starting material powder is a powdered catalyst or its precursor powder that contains at least molybdenum and bismuth as catalytic components and is used when gas-phase catalytic oxidation is carried out on propylene, isobutylene, primary butyl alcohol, tertiary butyl alcohol or methyl tert-butyl ether using molecular oxygen so as to produce their respectively corresponding unsaturated aldehyde and unsaturated carboxylic acid.

13. A method for manufacturing a catalyst for producing unsaturated aldehyde and unsaturated carboxylic acid, comprising:
producing an extrusion molding by the method according to Claim 12; and
applying heat on the extrusion molded product.

14. The method for manufacturing a catalyst for producing unsaturated aldehyde and unsaturated carboxylic acid according to Claim 13, wherein unsaturated aldehyde is (meth)acrolein, and unsaturated carboxylic acid is (meth)acrylic acid.

15. A method for producing (meth)acrylic acid, comprising:
manufacturing a catalyst for producing (meth)acrylic acid by the method according to Claim 11; and
producing (meth)acrylic acid through gas-phase catalytic oxidation of (meth)acrolein using the catalyst and molecular oxygen.

16. A method for producing (meth)acrolein and (meth)acrylic acid, comprising:
manufacturing a catalyst for producing (meth)acrolein and (meth)acrylic acid by the method according to Claim 14; and
producing (meth)acrolein and (meth)acrylic acid by carrying out gas-phase catalytic oxidation of propylene, isobutylene, primary butyl alcohol, tertiary butyl alcohol or

methyl tert-butyl ether using the catalyst and molecular oxygen.