

DESCRIPTION

TITLE OF INVENTION

Gasket Including Talc Sheet

5 TECHNICAL FIELD

[0001] The present invention relates to a gasket including a talc sheet and used in a joint of piping for fluid.

BACKGROUND ART

10 [0002] Typical gaskets are divided into the following three major types: non-metallic gaskets, semi-metallic gaskets, and metal jacketed gaskets. Non-metallic gaskets that are typically used under high-temperature conditions at 450°C or higher are heat-resistant sheet gaskets that contain inorganic filling material and inorganic fibers as well as rubber-covered woven gaskets that are made of inorganic fibers.

15 [0003] PTL 1 discloses a sealing material for a non-metallic gasket, in which the sealing material contains an inorganic fiber, an inorganic filling material, and a binding agent.

CITATION LIST

PATENT LITERATURE

[0004] PTL 1: Japanese Patent Laying-Open No. S59-86683

20 SUMMARY OF INVENTION

TECHNICAL PROBLEM

25 [0005] However, use of a gasket that includes a sealing material containing an inorganic fiber, an inorganic filling material, and a binding agent is proved to be accompanied by a so-called contact surface leakage or a leakage along a contact surface between the gasket and a flange, that is, a phenomenon that a fluid contained inside piping leaks out along the surface of the gasket. Thus, there is room for improvement in sealing properties.

[0006] An object of the present invention is to provide a gasket with improved sealing properties.

SOLUTION TO PROBLEM

[0007] The present invention provides a gasket including a talc sheet as described below.

5 [1] A gasket including at least one talc sheet containing talc, an inorganic fiber, and a binder, wherein each side of the at least one talc sheet has a ten-point average roughness (R_z) in accordance with JIS B 0031 (1994) of not greater than 20 μm .

[0008] [2] The gasket according to [1], wherein the inorganic fiber is at least one fiber selected from the group consisting of alumina fiber, glass fiber, rock wool, basalt fiber, biosoluble fiber, silica fiber, and ceramic fiber.

10 [0009] [3] The gasket according to [1] or [2], wherein the inorganic fiber is alumina fiber or basalt fiber.

[0010] [4] The gasket according to any one of [1] to [3], wherein the at least one talc sheet has a heated loss rate at 800°C in accordance with JIS K 7120 of not higher than 15 weight%.

15 [0011] [5] The gasket according to any one of [1] to [4], wherein the talc has a particle size not smaller than 2 μm and not greater than 25 μm .

[0012] [6] The gasket according to any one of [1] to [5], wherein the gasket includes a stacked body including the at least one talc sheet, the at least one talc sheet comprises two or more talc sheets, the stacked body includes a metal plate, the metal plate is made
20 of stainless steel material or carbon steel material, and the metal plate has at least one form selected from the group consisting of flat metal, metal mesh, metal hook, and expanded metal.

[0013] [7] The gasket according to any one of [1] to [6], wherein the gasket is at least one selected from the group consisting of a spiral gasket, a semi-metallic gasket, and a
25 metal jacketed gasket.

ADVANTAGEOUS EFFECTS OF INVENTION

[0014] In the gasket including a talc sheet according to the present invention, each side of the talc sheet has an R_z not greater than 20 μm . This configuration ensures sufficient affinity between the gasket and a flange and thereby may have a reduced

level of contact surface leakage between the gasket and the flange.

DESCRIPTION OF EMBODIMENTS

[0015] In the following, a more detailed description will be given of the gasket including a talc sheet according to the present invention.

5 [Average aspect ratio of talc]

Preferably, the talc used in the present invention has an average aspect ratio ranging from 10 to 25. The average aspect ratio of the talc herein refers to the ratio of the average diameter of talc particles to the average thickness of talc particles and may be calculated as $[(\text{Average diameter})/(\text{Average thickness})]$. When the average aspect ratio of the talc is lower than 10, R_z of each side of the talc sheet may exceed 20 μm .
10 The average aspect ratio of the talc has no particular upper limit thereto, but, normally, the average aspect ratio of the talc is not higher than 25. The specific method of measuring the average aspect ratio of the talc is described below in the Examples section.

15 [0016] [Average particle size of talc]

Preferably, the talc used in the present invention has an average particle size not smaller than 2 μm and not greater than 25 μm . When the average particle size of the talc is smaller than 2 μm , the talc sheet tends to be difficult to form. When the average particle size of the talc is greater than 25 μm , R_z of each side of the talc sheet may exceed 20 μm .
20 The average particle size of the talc is measured by using a laser-diffraction particle size distribution analyzer. The specific method of measuring the average particle size is described below in the Examples section.

[0017] [Inorganic fiber]

The inorganic fiber used in the present invention functions to enhance
25 mechanical strength of the talc sheet. As the inorganic fiber, alumina fiber, glass fiber, rock wool, basalt fiber, biosoluble fiber, silica fiber, ceramic fiber, and the like are preferable. Further preferably, alumina fiber is used for improving heat resistance and basalt fiber is used for improving mechanical strength.

[0018] [Average fiber diameter of inorganic fiber]

Preferably, the inorganic fiber used in the present invention has an average fiber diameter ranging from 3 to 20 μm . When the average fiber diameter of the inorganic fiber exceeds 20 μm , R_z of each side of the talc sheet may exceed 20 μm . When the average fiber diameter of the inorganic fiber is smaller than 3 μm , the talc sheet tends to have a decreased mechanical strength. The specific method of measuring the average fiber diameter of the inorganic fiber is described below in the Examples section.

[0019] [Binder]

The binder used in the present invention may be any binder as long as it is capable of binding talc to the inorganic fiber and thereby enhancing sealing properties and imparting mechanical strength to the talc sheet. For the purpose of suitably binding talc and the inorganic fiber in the talc sheet, an organic binder may be used, for example. Examples of the organic binder include acrylonitrile butadiene rubber, natural rubber, isoprene rubber, chloroprene rubber, acrylonitrile rubber, styrene-butadiene rubber, butyl rubber, fluorine rubber, silicone rubber, and ethylene-propylene rubber. One type of the binder may be used, or two or more types of the binder may be used in combination.

[0020] [Ten-point average roughness (R_z)]

According to the present invention, each side of the talc sheet has a ten-point average roughness (R_z) in accordance with JIS B 0031 (1994) of not greater than 20 μm . R_z may be measured in the following manner. First, from a roughness curve, an evaluation length (8 mm) is defined in the direction in which an average line extends. Then, the defined segment is subjected to measurement, with respect to the average line and in the depth amplitude direction. As for the highest to the fifth highest peaks, the average of the absolute values of the heights thereof is obtained. As for the deepest to the fifth deepest valleys, the absolute values of the depths thereof are obtained. Both the resulting values are summed and expressed in micrometers (μm) for use as R_z . The specific method of measuring R_z is described below in the Examples section.

[0021] [Heated loss rate]

Preferably, the talc sheet used in the present invention has a heated loss rate at

800°C in accordance with JIS K 7120 (Testing Methods of Plastics by Thermogravimetry) of not higher than 15%. When the heated loss rate at 800°C of the talc sheet exceeds 15%, sealing properties at high temperatures tend to degrade. The specific method of measuring the heated loss rate is described below in the Examples section.

[0022] The talc sheet used in the present invention may further contain various vulcanizing agents, vulcanization accelerators, vulcanization aids, colorants, and the like, as needed, in addition to the above-described components.

[0023] [Gasket]

The gasket according to the present invention includes the above-described talc sheet. For instance, the gasket according to the present invention may be easily produced by cutting the talc sheet into a desired shape. The gasket according to the present invention may include two or more talc sheets described above. The gasket according to the present invention may include two or more talc sheets described above as well as a reinforcing component for reinforcement, such as a thin metal plate, a metal mesh, and/or a metal hook. The reinforcing component may be made of stainless steel (SUS) material and/or carbon steel (SPCC) material.

[0024] The gasket including two or more talc sheets may be a stacked body including two or more talc sheets formed by pressing the two or more talc sheets to make them adhered to each other and stacked in a sequential manner. The stacked body including two or more talc sheets may further include a reinforcing component; for example, the stacked body including two or more talc sheets may have a structure made of a talc sheet, a reinforcing component, and a talc sheet stacked in a sequential manner.

[0025] The talc sheet may also be used as a filler in a spiral gasket, or a surface material of a semi-metallic gasket, or a core of a metal jacketed gasket.

[0026] [Method of producing talc sheet]

The talc sheet in the gasket according to the present invention may be produced by a dry process and/or a wet process, for example, both of which are typical processes employed for producing nonwoven fabric.

[0027] [Spiral gasket]

When the talc sheet is used as a filler, the gasket according to the present invention may be made as a spiral gasket. For example, the spiral gasket may be produced by using a hoop component made of a metal elementary substance and/or an alloy such as stainless steel material, carbon steel material, inconel, and hastelloy, stacking the filler and the hoop component, and winding them in a spiral manner.

[0028] [Semi-metallic gasket]

When the talc sheet is used as a surface material, the gasket according to the present invention may be made as a semi-metallic gasket. For example, the semi-metallic gasket may be produced by forming a layer of the talc sheet, which is used as a surface material, on each side of a metal component containing a metal elementary substance and/or an alloy such as stainless steel material, carbon steel material, inconel, and hastelloy and thereby achieving a semi-metal configuration.

[0029] [Metal jacketed gasket]

When the talc sheet is used as a core, the gasket according to the present invention may be made as a metal jacketed gasket. For example, the metal jacketed gasket may be produced by coating the outer side of the talc sheet, which is used as a core, with a thin metal film containing a metal elementary substance and/or an alloy such as stainless steel material, carbon steel material, inconel, and hastelloy.

EXAMPLES

[0030] In the following, the gasket according to the present invention will be described more specifically by way of examples. However, the scope of the present invention is not limited to the examples.

[0031] [Example 1]

A single talc sheet containing talc (MS-P (average particle size = 15 μm , average aspect ratio = 15), NIPPON TALC Co., Ltd.) by 80 parts by weight, alumina fibers (average fiber diameter = 5 to 10 μm) by 10 parts by weight, and acrylonitrile butadiene rubber by 10 parts by weight was prepared by a wet process. Three specimens were obtained from the resulting talc sheet and subjected to R_z evaluation.

Three gaskets were also prepared by using the talc sheet and subjected to evaluation of sealing properties. The talc sheet had a heated loss rate at 800°C in accordance with JIS K 7120 of 12.5%.

[0032] [Example 2]

5 Preparation and evaluation were carried out in the same manner as in Example 1 except that alumina fibers (average fiber diameter = 5 to 10 μm) by 7 parts by weight and basalt fibers (average fiber diameter = 5 to 10 μm) by 3 parts by weight were used as inorganic fibers. The talc sheet had a heated loss rate at 800°C in accordance with JIS K 7120 of 13.0%.

10 [0033] [Comparative Example 1]

A single vermiculite/talc sheet containing vermiculite (Grade 0 (average particle size = 0.7 mm), Vermitech) by 40 parts by weight, talc (MS-P (average particle size = 15 μm, average aspect ratio = 15), NIPPON TALC Co., Ltd.) by 40 parts by weight, rock wool (average fiber diameter = 5 to 10 μm) by 10 parts by weight, and
15 acrylonitrile butadiene rubber by 10 parts by weight was prepared by a wet process. Three specimens were obtained from the resulting vermiculite/talc sheet and subjected to R_Z evaluation. Three gaskets were also prepared by using the vermiculite/talc sheet and subjected to evaluation of sealing properties. The vermiculite/talc sheet had a heated loss rate at 800°C in accordance with JIS K 7120 of 13.5%.

20 [0034] [1] Conditions of measurement of average particle sizes of talc and vermiculite

The average particle size was measured by using a laser-diffraction particle size distribution analyzer (trade name "SALD-2000J" manufactured by Shimadzu Corporation). The average particle size was defined as a particle size in the particle size distribution obtained by this analyzer at which the cumulative value reached 50%
25 (median size).

[0035] [2] Conditions of measurement of average aspect ratio of talc

The average aspect ratio was measured by examination with a scanning electron microscope (trade name "S-3400N" manufactured by Hitachi High-Technologies Corporation) at a 1000-fold magnification. More specifically, a sample was fixed to

the platform of the scanning electron microscope and then an image was taken with the scanning electron microscope. 20 particles were randomly selected in the resulting image. The diameters and the thicknesses of these talc particles were measured, and the arithmetic mean of the diameters and the arithmetic mean of the thicknesses were
5 calculated. By using the resulting average diameter and the resulting average thickness of the talc particles, the ratio of the average diameter of the talc particles to the average thickness of the talc particles, [(Average diameter of talc particles)/(Average thickness of talc particles)], was determined. The resulting ratio was defined as the average aspect ratio.

10 [0036] [3] Conditions of measurement of average fiber diameter of inorganic fiber

The average fiber diameter was measured by examination with a scanning electron microscope (trade name "S-3400N" manufactured by Hitachi High-Technologies Corporation) at a 1000-fold magnification. More specifically, a sample was fixed to the platform of the scanning electron microscope and then an image was
15 taken with the scanning electron microscope. 20 particles were randomly selected in the resulting image. The fiber diameters were measured, and the arithmetic mean of these was calculated and defined as the average fiber diameter.

[0037] [4] Conditions of measurement of heated loss rate

A specimen was prepared by arbitrarily cutting each of the talc sheet and the vermiculite/talc sheet. The mass of the specimen was measured, and the resulting
20 mass was defined as a pre-heating mass. The specimen was placed in an aluminum dish, then heated from room temperature to 800°C with a thermal analyzer, which was a TG/DTA simultaneous measuring instrument (trade name DTG-60 manufactured by Shimadzu Corporation) at a temperature raising rate of 10°C/min in an air atmosphere
25 (air flow rate = 150 milliliter/min), and then left to cool to room temperature. The mass of the specimen was measured again, and the resulting mass was defined as an after-heating mass. The pre-heating mass and the after-heating mass thus measured were used for calculation of heated loss rate by equation (1) below.

$$(1) \text{ Heated loss rate (\%)} = ((\text{Pre-heating mass}) - (\text{After-heating mass})) / (\text{Pre-}$$

heating mass) $\times 100$

[5] Conditions of experiment for rated evaluation of R_Z of each side of sheet

R_Z of each side of the sheet was measured in accordance with JIS B 0031

(1994) with the use of SURFCOM 480A manufactured by Tokyo Seimitsu Co., Ltd.

5 Three specimens were prepared from the same talc sheet, and three specimens were prepared from the same vermiculite sheet. R_Z of each side of each sheet was measured. A single measurement was performed for each side.

[0038] Evaluation length: 8.0 mm

Evaluation speed: 0.3 mm/s

10 Cut-off value: 0.8 mm

[0039] (Criteria for R_Z evaluation)

A: R_Z of each side of sheet was not greater than 20 μm

B: R_Z of each side of sheet was greater than 20 μm

15 [0040] Table 1 below shows results of the experiment for rated evaluation of R_Z of each side of each sheet.

[0041]

Table 1

		R_Z (μm)		R_Z evaluation
		Front side	Back side	
Sheet prepared in Example 1	Specimen 1	17.5	18.1	A
	Specimen 2	16.0	15.3	A
	Specimen 3	18.7	16.3	A
Sheet prepared in Example 2	Specimen 4	18.5	18.9	A
	Specimen 5	17.6	18.4	A
	Specimen 6	19.0	18.6	A
Sheet prepared in Comparative Example 1	Specimen 7	24.5	25.4	B
	Specimen 8	22.4	23.1	B
	Specimen 9	21.5	21.8	B

20 [0042] As shown in Table 1, R_Z of each side of each of the six specimens obtained from the talc sheets prepared in Examples 1 and 2 was not greater than 20 μm . In contrast, R_Z of each side of each of the three specimens obtained from the

vermiculite/talc sheet prepared in Comparative Example 1 was greater than 20 μm .

[0043] [6] Conditions of experiment for rated evaluation of sealing properties

To a flange of piping for compressed gas, each of test gaskets 1 to 6 was attached. A compression tester was used for load application to achieve a surface pressure of 10 MPa. Into the piping for compressed gas, helium gas having a temperature of 35°C and a pressure of 0.2 MPa was introduced. The amount of helium leaked from the gasket was measured with a soap film flow meter.

[0044] (Criteria for evaluation of leaked amount)

A: Amount of leaked helium was lower than 5.0×10^{-2} ($\text{Pa} \cdot \text{m}^3/\text{s}$)

B: Amount of leaked helium was not lower than 5.0×10^{-2} ($\text{Pa} \cdot \text{m}^3/\text{s}$)

[0045] Table 2 below shows results of the experiment for rating.

[0046]

Table 2

		Leakage amount ($\text{Pa} \cdot \text{m}^3/\text{s}$)	Evaluation results
Gasket including talc sheet prepared in Example 1	Gasket 1	2.0×10^{-2}	A
	Gasket 2	1.5×10^{-2}	A
	Gasket 3	1.0×10^{-2}	A
Gasket including talc sheet prepared in Example 2	Gasket 4	2.5×10^{-2}	A
	Gasket 5	1.5×10^{-2}	A
	Gasket 6	2.5×10^{-2}	A
Gasket including vermiculite/talc sheet prepared in Comparative Example 1	Gasket 7	8.0×10^{-2}	B
	Gasket 8	7.5×10^{-2}	B
	Gasket 9	5.5×10^{-2}	B

[0047] As shown in Table 2, the amount of leaked helium measured for each of the six gaskets including a talc sheet prepared in Examples 1 and 2 was lower than 5.0×10^{-2} ($\text{Pa} \cdot \text{m}^3/\text{s}$). In contrast, the amount of leaked helium measured for each of the three gaskets including a vermiculite/talc sheet prepared in Comparative Example 1 was not lower than 5.0×10^{-2} ($\text{Pa} \cdot \text{m}^3/\text{s}$). These results have proved that the use of a gasket including a talc sheet with R_z not greater than 20 μm for each side achieves a reduced level of contact surface leakage between the gasket and a flange.

CLAIMS

1. A gasket comprising a talc sheet containing talc, an inorganic fiber, and a binder,
5 wherein both sides of the talc sheet have a ten-point average roughness (R_z) in accordance with JIS B 0031 (1994) of from $15.3\mu\text{m}$ to $20\mu\text{m}$,
wherein the talc sheet containing talc by 80 parts by weight, in relation to the talc sheet by 100 parts by weight,
wherein the talc has a particle size of from $2\mu\text{m}$ to $25\mu\text{m}$, and
10 wherein the average aspect ratio of the talc is 10 ~ 25.
2. The gasket according to claim 1, wherein the inorganic fiber is at least one fiber selected from the group consisting of alumina fiber, glass fiber, rock wool, basalt fiber, biosoluble fiber, silica fiber, and ceramic fiber.
15
3. The gasket according to claim 1 or 2, wherein the inorganic fiber is alumina fiber or basalt fiber.
4. The gasket according to claim 1 or 2, wherein the talc sheet has a heated
20 loss rate at 800°C in accordance with JIS K 7120 of not higher than 15 weight%.
5. The gasket according to claim 1 or 2, wherein
the gasket comprises a stacked body including the talc sheet, the talc sheet comprises two or more talc sheets,
25 the stacked body includes a metal plate,
the metal plate is made of stainless steel material or cold-rolled steel material,
and
the metal plate has at least one form selected from the group consisting of flat metal, metal mesh, metal hook, and expanded metal.
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6. The gasket according to claim 1 or 2, wherein the gasket is at least one

selected from the group consisting of a spiral gasket, a semi-metallic gasket, and a metal jacketed gasket.

7. The gasket according to claim 3, wherein the talc sheet has a heated loss rate
5 at 800°C in accordance with JIS K 7120 of not higher than 15 weight%.

8. The gasket according to claim 7, wherein
the gasket comprises a stacked body including the talc sheet, the talc sheet
comprises two or more talc sheets,
10 the stacked body includes a metal plate,
the metal plate is made of stainless steel material or cold-rolled steel material,
and
the metal plate has at least one form selected from the group consisting of flat
metal, metal mesh, metal hook, and expanded metal.