CLAIMS

1. A rotor/stator type mixer comprising a mixer unit that includes a stator having a plurality of openings formed thereon and a rotor disposed inwardly radially of the stator and spaced away from the stator with a specific gap, wherein the rotor disposed inwardly radially of the stator and spaced away from the stator with the specific gap includes:

a rotor peripheral wall that faces opposite the inside of the peripheral wall of the stator having the plurality of openings formed thereon and is located inwardly radially of the stator with the specific gap; and

a plurality of rotor openings formed on the rotor peripheral wall.

2. A rotor/stator type mixer as defined in Claim 1, wherein the stator includes a plurality of stators each having a different peripheral diameter and wherein the rotor peripheral wall of the rotor disposed inwardly radially of each of the stators is disposed so that it can be spaced away from each of the stators with a respective specific gap.

3. A rotor/stator type mixer as defined in Claim 1 or 2, wherein the stator and the rotor are provided so that they can be brought closer to or farther away from each other in the direction in which the rotary shaft of the rotor extends.

4. A rotor/stator type mixer as defined in any one of Claims 1 through 3, wherein the stator has an annular cover extending inwardly radially from the edge of the top end edge.

5. A rotor/stator type mixer as defined in Claim 4, wherein the annular cover has an inlet hole through which a fluid being processed can be introduced downwardly.

6. A rotor/stator type mixer as defined in any one of Claims 1 through 5, wherein each of the plurality of openings formed on the stator has a round shape.

7. A rotor/stator type mixer as defined in any one of Claims 1 through 6, wherein the plurality of openings formed on the stator represent over 20% of the total peripheral wall of the stator when it is expressed in terms of the opening-to-area ratio.

8. A rotor/stator type mixer as defined in any one of Claims 1 through 7, wherein the rotor has a plurality of agitating blades extending radially from the center point of the rotary shaft of the rotor.

9. A rotor/stator type mixer, wherein the mixer having the construction as defined in any one of Claims 1 through 8 is designed by calculating the Equation 1 listed below to estimate the mixer's particular running time and the resulting liquid drop diameters of the fluid being processed that are obtained during that mixer's particular running time, the mixer's design being such that it allows the resulting liquid drop diameters of the fluid being processed to be determined during the mixer's particular running time:

$$\varepsilon_a = \varepsilon_g + \varepsilon_s$$

$$= \left[\left(N_p - N_{qd}\pi^2\right)\cdot n_r\right]\left\{D^3\left[\left(\frac{D^3 b}{\delta(D+\delta)}\right)+\frac{\pi^2 n_s^{\,2} d^3(d+4\ell)}{4N_{qd}\left[n_s\cdot d^2+4\delta(D+\delta)\right]}\right]\right\}\left(\frac{N^4\cdot t_m}{V}\right)$$

$$= \left[\left(N_p - N_{qd}\pi^2\right)\cdot n_r\right]\left[D^3\left(K_g + K_s\right)\right]\cdot\left(\frac{N^4\cdot t_m}{V}\right)$$

$$= K_c\cdot\left(\frac{N^4\cdot t_m}{V}\right) \quad \cdots\cdots \quad \text{Equation 1}$$

In the Equation 1,

ε_a : Total energy dissipation rate (m^2/s^3)

ε_g : Local shear stress in the gap between the rotor and stator (m^2/s^3)

ε_s : Local energy dissipation rate in the stator (m^2/s^3)

N_p : Number of powers (·)

Nqd : Number of flow rates (-)

n_r : Number of rotor blades (-)

D : Diameter of rotor (m)

b : Thickness of rotor blade tip (m)

δ : Gap between rotor and stator (m)

n_s : Number of stator holes (-)

d : Diameter of stator hole (m)

l : Thickness of stator (m)

N : Number of rotations (l/s)

t_m : Mixing time (s)

V : Flow rate (m^3)

K_g : Configuration dependent term (m^2)

K_s Configuration dependent term in stator (m^2)

K_c : Configuration dependent term for the entire mixer

10. A rotor/stator type mixer as defined in any one of Claims 1 through 8, wherein the mixer can be scaled up or scaled down by calculating the Equation 1 listed below to estimate the mixer's particular running time and the resulting liquid drop diameters that can be obtained during that mixer's particular running time:

$$\varepsilon_a = \varepsilon_g + \varepsilon_s$$

$$= \left[\left(N_p - N_{qd}\pi^2\right) n_r\right]\left\{D^3\left[\left(\frac{D^3 b}{\delta(D+\delta)}\right) + \frac{\pi^2 n_s^2 d^3 (d+4\ell)}{4N_{qd}\left[n_s \cdot d^2 + 4\delta(D+\delta)\right]}\right]\right\}\left(\frac{N^4 \cdot t_m}{V}\right)$$

$$= \left[\left(N_p - N_{qd}\pi^2\right) \cdot n_r\right] \cdot \left[D^3\left(K_g + K_s\right)\right] \cdot \left(\frac{N^4 \cdot t_m}{V}\right)$$

$$= K_c \cdot \left(\frac{N^4 \cdot t_m}{V}\right) \quad \cdots\cdots\cdots \quad \text{Equation 1}$$

In the Equation 1,

ε_a : Total energy dissipation rate (m^2/s^3)

ε_g : Local shear stress in the gap between the rotor and stator (m^2/s^3)

ε_s : Local energy dissipation rate in the stator (m^2/s^3)

N_p : Number of powers (-)

Nqd : Number of flow rates (-)

n_r : Number of rotor blades (-)

D : Diameter of rotor (m)

b : Thickness of rotor blade tip (m)

δ : Gap between rotor and stator (m)

n_s : Number of stator holes (-)

d : Diameter of stator hole (m)

l : Thickness of stator (m)

N : Number of rotations (l/s)

t_m : Mixing time (s)

V : Flow rate (m^3)

K_g : Configuration dependent term (m^2)

K_s Configuration dependent term in stator (m^2)

K_c : Configuration dependent term for the entire mixer

11. A method of manufacturing foods, pharmaceutical medicines or chemical products by using the rotor/stator type mixer as defined in any one of Claims 1 through 8 in which the fluid being processed is subjected to the emulsifying, dispersing, particle size breaking up or mixing operation, wherein the foods, pharmaceutical medicines or chemical products are manufactured by calculating the Equation 1 listed below to estimate the mixer's particular running time and the resulting liquid drop diameters obtained during that mixer's particular running time:

$$\varepsilon_a = \varepsilon_g + \varepsilon_s$$

$$= \left[\left(N_p - N_{qd}\pi^2\right)\cdot n_r\right]\left\{D^3\left[\left(\frac{D^3 b}{\delta(D+\delta)}\right) + \frac{\pi^2 n_s^2 d^3(d+4\ell)}{4N_{qd}\left[n_s \cdot d^2 + 4\delta(D+\delta)\right]}\right]\right\}\left(\frac{N^4 \cdot t_m}{V}\right)$$

$$= \left[\left(N_p - N_{qd}\pi^2\right)\cdot n_r\right]\cdot\left[D^3\left(K_g + K_s\right)\right]\cdot\left(\frac{N^4 \cdot t_m}{V}\right)$$

$$= K_c \cdot \left(\frac{N^4 \cdot t_m}{V}\right) \quad \cdots\cdots\cdots \quad \text{Equation 1}$$

In the Equation 1,

ε_a : Total energy dissipation rate (m^2/s^3)

ε_g : Local shear stress in the gap between the rotor and stator (m^2/s^3)

ε_s : Local energy dissipation rate in the stator (m^2/s^3)

N_p : Number of powers (-)

Nqd : Number of flow rates (-)

n_r : Number of rotor blades (-)

D : Diameter of rotor (m)

b : Thickness of rotor blade tip (m)

δ : Gap between rotor and stator (m)

n_s : Number of stator holes (-)

d : Diameter of stator hole (m)

l : Thickness of stator (m)

N : Number of rotations (l/s)

t_m : Mixing time (s)

V : Flow rate (m^3)

K_g : Configuration dependent term (m^2)

K_s Configuration dependent term in stator (m^2)

K_c : Configuration dependent term for the entire mixer

12. Foods, pharmaceutical medicines or chemical products that are

manufactured by using the manufacturing method as defined in Claim 11.

CLAIMS

1. A rotor/stator type mixer comprising a mixer unit that includes a stator having a plurality of openings formed thereon and a rotor disposed inwardly radially of the stator and spaced away from the stator with a specific gap, wherein the rotor disposed inwardly radially of the stator and spaced away from the stator with the specific gap includes:

a rotor peripheral wall that is supported by a plurality of agitating blades extending radially from the center point of a rotary shaft of the rotor and faces opposite the inside of the peripheral wall of the stator having the plurality of openings formed thereon and is located inwardly radially of the stator with the specific gap; and

a plurality of rotor openings formed on the rotor peripheral wall;

wherein the mixer is designed by calculating the Equation 1 listed below to estimate the mixer's particular running time and the resulting liquid drop diameters of the fluid being processed that are obtained during that mixer's particular running time, the mixer's design being such that it allows the resulting liquid drop diameters of the fluid being processed to be determined during the mixer's particular running time:

$$\varepsilon_a = \varepsilon_g + \varepsilon_s$$

$$= \left[\left(N_p - N_{qd}\pi^2\right)\cdot n_r\right]\left\{D^3\left[\left(\frac{D^3 b}{\delta(D+\delta)}\right) + \frac{\pi^2 n_s^{\,2} d^3 (d+4\ell)}{4N_{qd}\left[n_s \cdot d^2 + 4\delta(D+\delta)\right]}\right]\right\}\left(\frac{N^4 \cdot t_m}{V}\right)$$

$$= \left[\left(N_p - N_{qd}\pi^2\right)\cdot n_r\right]\cdot\left[D^3\left(K_g + K_s\right)\right]\cdot\left(\frac{N^4 \cdot t_m}{V}\right)$$

$$= K_c \cdot \left(\frac{N^4 \cdot t_m}{V}\right) \quad \cdots\cdots\cdots \quad \text{Equation 1}$$

In the Equation 1,

ε_a : Total energy dissipation rate (m^2/s^3)

ε_g : Local shear stress in the gap between the rotor and stator (m^2/s^3)

ε_s : Local energy dissipation rate in the stator (m^2/s^3)

N_p : Number of powers (-)

Nqd : Number of flow rates (-)

n_r : Number of rotor blades (-)

D : Diameter of rotor (m)

b : Thickness of rotor blade tip (m)

δ : Gap between rotor and stator (m)

n_s : Number of stator holes (-)

d : Diameter of stator hole (m)

l : Thickness of stator (m)

N : Number of rotations (l/s)

t_m : Mixing time (s)

V : Flow rate (m^3)

K_g : Configuration dependent term (m^2)

K_s Configuration dependent term in stator (m^2)

K_c : Configuration dependent term for the entire mixer

2. A rotor/stator type mixer as defined in Claim 1, wherein the stator includes a plurality of stators each having a different peripheral diameter and wherein the rotor peripheral wall of the rotor disposed inwardly radially of each of the stators is disposed so that it can be spaced away from each of the stators with a respective specific gap.

3. A rotor/stator type mixer as defined in Claim 1, wherein the stator and the rotor are provided so that they can be brought closer to or farther away from each other in the direction in which the rotary shaft of the rotor extends.

4. A rotor/stator type mixer as defined in Claim 1, wherein the stator has an annular cover extending inwardly radially from an edge of the top end edge.

5. A rotor/stator type mixer as defined in Claim 4, wherein the annular cover has an inlet hole through which a fluid being processed can be introduced downwardly.

6. A rotor/stator type mixer as defined in Claim 1, wherein each of the plurality of openings formed on the stator has a round shape.

7. A rotor/stator type mixer as defined in Claim 1, wherein the plurality of openings formed on the stator represent over 20% of the total peripheral wall of the stator when it is expressed in terms of the opening-to-area ratio.

8. A method of manufacturing foods, pharmaceutical medicines or chemical products by using a rotor/stator type mixer comprising a mixer unit that includes a stator having a plurality of openings formed thereon and a rotor disposed inwardly radially of the stator and spaced away from the stator with a specific gap in which the rotor disposed inwardly radially of the stator and spaced away from the stator with the specific gap includes:

a rotor peripheral wall that is supported by a plurality of agitating blades extending radially from the center point of a rotary shaft of the rotor and faces opposite the inside of the peripheral wall

of the stator having the plurality of openings formed thereon and is located inwardly radially of the stator with the specific gap; and

a plurality of rotor openings formed on the rotor peripheral wall; and the fluid being processed is subjected to the emulsifying, dispersing, particle size breaking up or mixing operation, wherein the foods, pharmaceutical medicines or chemical products are manufactured by calculating the Equation 1 listed below to estimate the mixer's particular running time and the resulting liquid drop diameters obtained during that mixer's particular running time:

$$\varepsilon_a = \varepsilon_g + \varepsilon_s$$

$$= \left[\left(N_p - N_{qd}\pi^2\right)\cdot n_r\right]\left\{D^3\left[\left(\frac{D^3 b}{\delta(D+\delta)}\right)+\frac{\pi^2 n_s{}^2 d^3(d+4\ell)}{4N_{qd}\left[n_s\cdot d^2+4\delta(D+\delta)\right]}\right]\right\}\left(\frac{N^4\cdot t_m}{V}\right)$$

$$= \left[\left(N_p - N_{qd}\pi^2\right)\cdot n_r\right]\cdot\left[D^3\left(K_g + K_s\right)\right]\cdot\left(\frac{N^4\cdot t_m}{V}\right)$$

$$= K_c\cdot\left(\frac{N^4\cdot t_m}{V}\right) \quad \cdots\cdots\cdots \quad \text{Equation 1}$$

In the Equation 1,

ε_a : Total energy dissipation rate (m^2/s^3)

ε_g : Local shear stress in the gap between the rotor and stator (m^2/s^3)

ε_s : Local energy dissipation rate in the stator (m^2/s^3)

N_p : Number of powers (-)

Nqd : Number of flow rates (-)

n_r : Number of rotor blades (-)

D : Diameter of rotor (m)

b : Thickness of rotor blade tip (m)

δ : Gap between rotor and stator (m)

n_s : Number of stator holes (-)

d : Diameter of stator hole (m)

l : Thickness of stator (m)

N : Number of rotations (1/s)

t_m : Mixing time (s)

V : Flow rate (m^3)

K_g : Configuration dependent term (m^2)

K_s Configuration dependent term in stator (m^2)

K_c : Configuration dependent term for the entire mixer

9. A rotor/stator type mixer comprising a mixer unit that includes a stator having a plurality of openings formed thereon and a rotor disposed inwardly radially of the stator and spaced away from the stator with a specific gap, wherein the rotor disposed inwardly radially of the stator and spaced away from the stator with the specific gap includes:

a rotor peripheral wall that is supported by a plurality of agitating blades extending radially from the center point of a rotary shaft of the rotor and faces opposite the inside of the peripheral wall of the stator having the plurality of openings formed thereon and is located inwardly radially of the stator with the specific gap; and

a plurality of rotor openings formed on the rotor peripheral wall;

wherein the mixer can be scaled up or scaled down by calculating the Equation 1 listed below to estimate the mixer's particular running time and the resulting liquid drop diameters that can be obtained during that mixer's particular running time:

$$\varepsilon_a = \varepsilon_g + \varepsilon_s$$

$$= \left[\left(N_p - N_{qd}\pi^2\right)\cdot n_r\right]\left\{D^3\left[\left(\frac{D^3 b}{\delta(D+\delta)}\right)+\frac{\pi^2 n_s^2 d^3(d+4\ell)}{4N_{qd}\left[n_s\cdot d^2+4\delta(D+\delta)\right]}\right]\right\}\left(\frac{N^4\cdot t_m}{V}\right)$$

$$= \left[\left(N_p - N_{qd}\pi^2\right)\cdot n_r\right]\cdot\left[D^3\left(K_g + K_s\right)\right]\cdot\left(\frac{N^4\cdot t_m}{V}\right)$$

$$= K_c\cdot\left(\frac{N^4\cdot t_m}{V}\right) \quad \cdots\cdots\cdots \quad \text{Equation 1}$$

In the Equation 1,

ε_a : Total energy dissipation rate (m^2/s^3)

ε_g : Local shear stress in the gap between the rotor and stator (m^2/s^3)

ε_s : Local energy dissipation rate in the stator (m^2/s^3)

N_p : Number of powers (-)

Nqd : Number of flow rates (-)

n_r : Number of rotor blades (-)

D : Diameter of rotor (m)

b : Thickness of rotor blade tip (m)

δ : Gap between rotor and stator (m)

n_s : Number of stator holes (-)

d : Diameter of stator hole (m)

l : Thickness of stator (m)

N : Number of rotations (l/s)

t_m : Mixing time (s)

V : Flow rate (m^3)

K_g : Configuration dependent term (m^2)

K_s Configuration dependent term in stator (m^2)

K_c : Configuration dependent term for the entire mixer

10. A rotor/stator type mixer as defined in Claim 9, wherein the stator includes a plurality of stators each having a different peripheral diameter and wherein the rotor peripheral wall of the rotor disposed inwardly radially of each of the stators is disposed so that it can be spaced away from each of the stators with a respective specific gap.

11. A rotor/stator type mixer as defined in Claim 9, wherein the stator and the rotor are provided so that they can be brought closer to or farther away from each other in the direction in which the rotary shaft of the rotor extends.

12. A rotor/stator type mixer as defined in Claim 9, wherein the stator has an annular cover extending inwardly radially from an edge of the top end edge.

13. A rotor/stator type mixer as defined in Claim 12, wherein the annular cover has an inlet hole through which a fluid being processed can be introduced downwardly.

14. A rotor/stator type mixer as defined in Claim 9, wherein each of the plurality of openings formed on the stator has a round shape.

15. A rotor/stator type mixer as defined in Claim 9, wherein the plurality of openings formed on the stator represent over 20% of the total peripheral wall of the stator when it is expressed in terms of the opening-to-area ratio.