CLAIMS

1. A mixer of a rotor-stator type comprising a mixer unit that includes a stator having a plurality of openings and a rotor disposed on an inner side of the stator and spaced by a predetermined gap away from the stator, wherein

said stator includes a plurality of stators each having a different peripheral diameter and said rotor is disposed in such a manner that it is spaced by predetermined gaps away from said plurality of stators,

said rotor has a plurality of agitating blades extending radially from its center of rotation, said gaps being formed between wall surfaces on radially outer ends of each of said agitating blades and inner peripheral wall surfaces of said stators, and

said stators and said rotor are arranged so that they can be brought closer to or farther away from each other in the direction in which a rotary shaft of said rotor extends.

2. The mixer as defined in claim 1, wherein a fluid being processed is introduced into a gap portion between said stator~~s~~ and said rotor which is disposed on the inner side of the stator and spaced by the predetermined gap away from the stator.

3. The mixer as defined in claim 1, wherein said stator has an annular cover that extends inwardly from an upper end edge thereof.

4. The mixer as defined in claim 3, wherein said annular cover has an inlet hole through which a fluid being processed is introduced downwardly, the inlet hole being located on a radial inner side of the stator that has the smallest diameter among said plurality of stators.

5. The mixer as defined in any one of claims 1 through 4, wherein that the openings provided on each of said stators have a round shape.

6. The mixer as defined in any one of claims 1 through 5, wherein the openings on said plurality of stators are provided around a peripheral wall of each of said stators, and represent more than 20% of the total opening area.

7. A method for designing the mixer as defined in any one of claims 1 through 6, wherein a construction of the mixer is so designed by using Equation 1 below to calculate a running time of said mixer and resulting liquid drop diameters of a fluid being processed which can be obtained during the running time that particular liquid drop diameters of the fluid being processed can be obtained during a particular mixer running time when said mixer is used to subject the fluid being processed to the emulsification, dispersion, particle size breakup or mixing processing:

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

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

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

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

In 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 (-)

N_{qd}: 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 (m^5).

8. A method for scaling up or scaling down the mixer as defined in any one of claims 1 through 6, wherein

when the mixer is scaled up or scaled down, a total energy dissipation rate [m^2/s^3] obtained by using Equation 1 below is agreed, so that predetermined liquid drop diameters of a fluid being processed can be obtained during a particular mixer running time when said mixer is used to subject the fluid being processed for emulsification, dispersion, particle size breakup or mixing processing by calculating a particular mixer running time and resulting liquid drop diameters for the fluid being processed thus obtained during the particular mixer running time using Equation 1 below:

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

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

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

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

In 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 (-)

N_{qd}: 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 (m^5).

9. A method for manufacturing the foods, pharmaceutical medicines or chemical products by using the mixer as defined in any one of claims 1 through 7 to subject a fluid being processed to the emulsification, dispersion, particle size breakup or mixing processing, wherein the foods, pharmaceutical medicines or chemical products having desired resulting drop diameters are manufactured by using Equation 1 below to calculate a particular mixer running time and the resulting drop diameters for the fluid being processed thus obtained during the particular mixer running time:

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

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

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

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

In 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 (-)

N_{qd} : 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 (m^5).