Claims

1. A catalytic filter module for gaseous fluids comprising
a block-shaped filter element,
a catalytic element and
a clean gas collecting and discharge arrangement,
wherein said catalytic element is substantially coextensive with the filter element,
said filter element having a feed face and on its opposite side a discharge face from which filtrate exits to be received by the upstream face of the catalytic element, the gaseous fluid exiting the catalytic element as clean gas at a clean gas face thereof opposite to the upstream face,
and wherein said clean gas collecting and discharge arrangement comprises one or more channels extending across the whole clean gas face of the catalytic element deflecting and directing the clean gas flow transverse to the vertical of the clean gas face of the catalytic element to a clean gas discharge opening of the filter module at a side face thereof.

2. The catalytic filter module according to claim 1, wherein said catalytic element is a compartment accommodating a fluidized bed or fixed bed of catalytic particles.

3. The catalytic filter module according to claim 1, wherein said catalytic element is a porous body of a fibrous and/or foam material comprising a catalyst.

4. The catalytic filter module according to claim 3, wherein the catalyst is being applied to the body of the catalytic element by coating or impregnating same.

5. The catalytic filter module according to claim 3 or 4, wherein the pore size of the catalytic element is larger than the pore size of the filter element.

6. The catalytic filter module according to any one of claims 1 to 5, wherein the catalytic element is a redox catalytic element, a catalytic element for NO reduction and/or a catalytic element for tar removal.

7. The catalytic filter module of any one of claims 1 to 6, wherein the catalytic element comprises on its upstream face a filter layer to provide a safety fuse functionality to the catalytic element.

8. The filter module of any one of claims 1 to 7, wherein the one or more channels of the clean gas collecting and discharge arrangement have a height, measured as the clearance in the direction of the vertical of the clean gas face of the catalytic element, in the range of from 0.1 to 0.7 times the distance of the feed face of the filter element from the clean gas face of the catalytic element.

9. The filter module according to claim 8, wherein the height is in the range of from 0.3 to 0.5 times the distance of the feed face of the filter element from the clean gas face of the catalytic element.

10. The filter module according to any one of claims 1 to 7, wherein the filter module comprises
a first set of a block-shaped filter element and a catalytic element and a second set of a block-shaped filter element and a catalytic element, the first and second sets being arranged spaced apart from one another and oriented back-to-back with the clean gas faces of the respective catalytic elements,
said clean gas collecting and discharge arrangement being designed as a common arrangement for the first and second set and positioned in

between the first and second sets receiving clean gas from the clean gas faces of the catalytic elements of the first and second sets.

11. The filter module according to claim 10, wherein the one or more channels of the clean gas collecting and discharge arrangement have a height, measured as the clearance in the direction of the vertical of the clean gas faces of the sets, in the range of from 0.2 to 1.4 times the distance of the feed face of the filter element from the clean gas face of the catalytic element of one set.

12. The filter module according to claim 11, wherein the height is in the range of from 0.6 to 1 times the distance of the feed face of the filter element from the clean gas face of the catalytic element of one set.

13. The filter module according to any one of claims 1 to 12, wherein the one or more channels of the clean gas collecting and discharge arrangement are oriented with their longitudinal direction in an angle of 30° or more to the vertical of the clean gas face of the catalytic element of the filter module.

14. The filter module according to claim 13, wherein the one or more channels of the clean gas collecting and discharge arrangement are oriented with their longitudinal direction in an angle of 60° or more to the vertical of the clean gas face of the catalytic element of the filter module.

15. The filter module according to claim 14, wherein the one or more channels of the clean gas collecting and discharge arrangement are oriented with their longitudinal direction in an angle of 90° to the vertical of the clean gas face of the catalytic element of the filter module.

16. The catalytic filter module according to any one of claims 1 to 15, wherein said filter element comprises a honey-comb structure, comprising a plurality of raw gas ducts and filtrate ducts, the raw gas ducts being separated from the filtrate ducts by tubular wall parts, the raw gas ducts being open at the feed face of the filter element and closed at the discharge face thereof, said filtrate ducts being closed at the feed face of the filter element and open at the discharge face thereof.

17. The catalytic filter module according to claim 16, wherein said raw gas ducts and filtrate ducts being oriented parallel or slanted in an angle of from 10° to 60° to the vertical of the feed face of the filter element.

18. The catalytic filter module according to claim 17, wherein said raw gas ducts and filtrate ducts being oriented parallel or slanted in an angle of from 30° to 60° to the vertical of the feed face of the filter element.

19. The filter module according to any one of claims 16 to 18, wherein the cross section of the tubular wall parts of the filter elements is of a polygonal, especially rectangular shape.

20. The filter module according to claim 19, wherein the polygonal is square, circular or oval shape.

21. The filter module according to claim 19 or 20, wherein the tubular wall parts have a cross-sectional area corresponding to the area of a square with an edge length of 3 to 20 mm.

22. The filter module according to claim 21, wherein the tubular wall parts have a cross-sectional area corresponding to the area of a square with an edge length of 5 to 10 mm.

23. The filter module according to any one of claims 19-22, wherein the length of the tubular wall parts of the filter elements amounts to 300 mm or less.

24. The filter module according to claim 23, wherein the length of the tubular wall parts of the filter elements amounts to 30 to 200 mm.

25. The filter module according to claim 24, wherein the length of the tubular wall parts of the filter elements amounts to 50 to 150 mm.

26. A catalytic filter system comprising a filter housing and one or more catalytic filter modules according to any one of claims 1 to 25 accommodated in said housing, said housing comprising an interior space separated into a raw gas and a clean gas chamber, said filter module(s) being arranged within said interior space, the feed side(s) of the filter element(s) oriented substantially vertical, said feed side(s) of the filter element(s) being in fluid communication with the raw gas chamber and said clean gas discharge opening(s) of the filter module(s) being in fluid communication with the clean gas chamber of the housing.

27. The catalytic filter system according to claim 26, wherein the system comprises a back-pulse arrangement.

28. The catalytic filter system of claim 26 or 27, wherein the housing comprises a tube sheet separating the interior of the housing into the raw gas and clean gas chamber, said tube sheet comprising openings accommodating the two or more filter modules.

29. The catalytic filter system of claim 28, wherein the two or more filter modules are in parallel orientation to one another.

30. The filter system according to any one of claims 26 to 29, wherein the filter modules are accommodated in the housing with a parallel orientation of the feed sides.

31. The filter system according to claim 30, wherein the feed side of one filter module faces the clean gas side of an adjacent module.

32. The filter system of claim 30 or 31, wherein the filter modules are arranged in a staggered configuration.

33. The filter system according to any one of claims 26 to 29, wherein the filter modules are accommodated in the housing with a parallel orientation of their feed sides, the feed sides of one module facing the feed side of an adjacent module.

34. The filter system of claim 33, wherein the system further includes partition plates positioned in between two adjacent filter modules.

35. The filter system according to any one of claims 26 to 34, wherein two or more filter modules are mounted in a common rack.

36. The filter system according to claim 35, wherein two or more filter modules have their clean gas collecting and discharge arrangements fluidly connected to one another.

37. The filter system according to claim 36, wherein the system comprises a clean gas discharge channel into which the discharge ends of the clean gas collecting and discharge arrangements substantially directly feed the clean gas via the clean gas openings of the filter modules.

Claims

1. A catalytic filter module for gaseous fluids comprising
a block-shaped filter element,
a catalytic element, and
a clean gas collecting and discharge arrangement,
wherein said catalytic element is substantially coextensive with the filter element,
said filter element having a feed face and on its opposite side a discharge face from which filtrate exits to be received by the upstream face of the catalytic element, the gaseous fluid exiting the catalytic element as clean gas at a clean gas face thereof opposite to the upstream face, the catalytic element having a pore size larger than the pore size of the filter element,
wherein said clean gas collecting and discharge arrangement comprises one or more channels extending across the whole clean gas face of the catalytic element deflecting and directing the clean gas flow transverse to the vertical of the clean gas face of the catalytic element to a clean gas discharge opening of the filter module at a side face thereof,
wherein said filter element comprises a honey-comb structure, comprising a plurality of raw gas ducts and filtrate ducts, the raw gas ducts being separated from the filtrate ducts by tubular wall parts, the raw gas ducts being open at the feed face of the filter element and closed at the discharge face thereof, said filtrate ducts being closed at the feed face of the filter element and open at the discharge face thereof,
wherein the one or more channels of the clean gas collecting and discharge arrangement have a height, measured as the clearance in the direction of the vertical of the clean gas face of the catalytic element, in the range of from 0.3 to 0.5 times the distance of the feed face of the filter element from the clean gas face of the catalytic element,
and wherein the axial length of the tubular wall parts of the filter elements amounts to 10 mm to 300 mm.

2. The catalytic filter module according to claim 1, wherein said catalytic element is a compartment accommodating a fluidized bed or fixed bed of catalytic particles.

3. The catalytic filter module according to claim 1, wherein said catalytic element is a porous body of a fibrous and/or foam material comprising a catalyst.

4. The catalytic filter module according to claim 3, wherein the catalyst is being applied to the body of the catalytic element by coating or impregnating same.

5. The catalytic filter module according to any one of claims 1 to 4, wherein the catalytic element is a redox catalytic element, a catalytic element for NO reduction and/or a catalytic element for tar removal.

6. The catalytic filter module according to any one of claims 1 to 5, wherein the catalytic element comprises on its upstream face a filter layer to provide a safety fuse functionality to the catalytic element.

7. A catalytic filter module for gaseous fluids comprising
a first set of a block-shaped filter element and a catalytic element and
a second set of a block-shaped filter element and a catalytic element,
the first and second sets being arranged spaced apart from one another and oriented back-to-back with the clean gas faces of the respective catalytic elements, said catalytic elements being substantially coextensive with the respective filter elements,
said filter elements having a feed face and on their opposite side a discharge face from which filtrate exits to be received by the upstream face of the catalytic elements, the gaseous fluid exiting the catalytic elements as clean gas at respective clean gas faces thereof opposite to the upstream faces, the catalytic elements having a pore size larger than the pore size of the filter element,
a clean gas collecting and discharge arrangement,
wherein said clean gas collecting and discharge arrangement comprises one or more channels extending across the whole clean gas faces of the catalytic elements deflecting and directing the clean gas flow transverse to the vertical of the clean gas faces of the catalytic elements to a clean gas

discharge opening of the filter module at a side face thereof,
said clean gas collecting and discharge arrangement being designed as a common arrangement for the first and second set and positioned in between the first and second sets receiving clean gas from the clean gas faces of the catalytic elements of the first and second sets; wherein said filter elements comprise a honey-comb structure, comprising a plurality of raw gas ducts and filtrate ducts, the raw gas ducts being separated from the filtrate ducts by tubular wall parts, the raw gas ducts being open at the feed face of the filter element and closed at the discharge face thereof, said filtrate ducts being closed at the feed face of the filter element and open at the discharge face thereof,
and wherein the axial length of the tubular wall parts of the filter elements amounts to 10 mm to 300 mm.

8. The catalytic filter module according to claim 7, wherein the one or more channels of the clean gas collecting and discharge arrangement have a height, measured as the clearance in the direction of the vertical of the clean gas faces of the sets, in the range of from 0.2 to 1.4 times the distance of the feed face of the filter element from the clean gas face of the catalytic element of one set.

9. The catalytic filter module according to claim 8, wherein the height is in the range of from 0.6 to 1 times the distance of the feed face of the filter element from the clean gas face of the catalytic element of one set.

10. The catalytic filter module according to any one of claims 1 to 9, wherein the one or more channels of the clean gas collecting and discharge arrangement are oriented with their longitudinal direction in an angle of 30° or more to the vertical of the clean gas face of the catalytic element of the filter module.

11. The catalytic filter module according to claim 10, wherein the one or more channels of the clean gas collecting and discharge arrangement are oriented with their longitudinal direction in an angle of 60° or more to the vertical of the clean gas face of the catalytic element of the filter module.

12. The catalytic filter module according to claim 10, wherein the one or more channels of the clean gas collecting and discharge arrangement are oriented with their longitudinal direction in an angle of 90° to the vertical of the clean gas face of the catalytic element of the filter module.

13. The catalytic filter module according to any one of claims 1 to 12, wherein said raw gas ducts and filtrate ducts being oriented parallel or slanted in an angle of from 10° to 60° to the vertical of the feed face of the filter element.

14. The catalytic filter module according to claim 13, wherein said raw gas ducts and filtrate ducts being oriented parallel or slanted in an angle of from 30° to 60° to the vertical of the feed face of the filter element.

15. The catalytic filter module according to claim 13 or 14, wherein the cross section of the tubular wall parts of the filter elements is of a polygonal, especially rectangular shape.

16. The catalytic filter module according to claim 15, wherein the polygonal shape is a square, circular or oval shape.

17. The catalytic filter module according to claim 15 or 16, wherein the tubular wall parts have a cross-sectional area corresponding to the area of a square with an edge length of 3 to 20 mm.

18. The catalytic filter module according to claim 17, wherein the tubular wall parts have a cross-sectional area corresponding to the area of a square with an edge length preferably of 5 to 10 mm.

19. The catalytic filter module according to any one of claims 1-18, wherein the axial length of the tubular wall parts of the filter elements amounts to 300 mm or less.

20. The catalytic filter module according to claim 19, wherein the axial length of the tubular wall parts of the filter elements amounts to 30 to 200 mm.

21. The catalytic filter module according to claim 20, wherein the axial length of the tubular wall parts of the filter elements amounts to 50 to 150 mm.

22. A catalytic filter system comprising a filter housing and one or more catalytic filter modules according to any one of claims 1 to 21 accommodated in said housing, said housing comprising an interior space separated into a raw gas and a clean gas chamber, said filter module(s) being arranged within said interior space, the feed side(s) of the filter element(s) oriented substantially vertical, said feed side(s) of the filter element(s) being in fluid communication with the raw gas chamber and said clean gas discharge opening(s) of the filter module(s) being in fluid communication with the clean gas chamber of the housing.

23. The catalytic filter system according to claim 22, wherein the system comprises a back-pulse arrangement.

24. The catalytic filter system according to claim 22 or 23, wherein the housing comprises a tube sheet separating the interior of the housing into the raw gas and clean gas chamber, said tube sheet comprising openings accommodating the two or more filter modules.

25. The catalytic filter system according to claim 24, wherein the two or more filter modules are in parallel orientation to one another.

26. The catalytic filter system according to any one of claims 22 to 25, wherein the filter modules are accommodated in the housing with a parallel orientation of the feed sides.

27. The catalytic filter system according to claim 26, wherein the feed side of one filter module facing the clean gas side of an adjacent module.

28. The catalytic filter system according to claim 26 or 27, wherein the filter modules being arranged in a staggered configuration.

29. The catalytic filter system according to any one of claims 22 to 25, wherein the filter modules are accommodated in the housing with a parallel orientation of their feed sides, the feed sides of one module facing the feed side of an adjacent module.

30. The catalytic filter system according to claim 29, wherein the system further includes partition plates positioned in between two adjacent filter modules.

31. The catalytic filter system according to any one of claims 22 to 30, wherein two or more filter modules are mounted in a common rack.

32. The catalytic filter system according to claim 31, wherein two or more filter modules have their clean gas collecting and discharge arrangements fluidly connected to one another.

33. The catalytic filter system according to claim 32, wherein the system comprises a clean gas discharge channel into which the discharge ends of the clean gas collecting and discharge arrangements substantially directly feed the clean gas via the clean gas openings of the filter modules.