[4a] In one aspect, there is provided a method comprising: providing at least one filter medium; wherein the at least one filter medium comprises: at least one catalyst material; and ammonium bisulfate (ABS), ammonium sulfate (AS), or any combination thereof; flowing a flue gas stream through or by the at least one filter medium; wherein the flue gas stream comprises: NO_x compounds comprising: Nitric Oxide (NO), and Nitrogen Dioxide (NO_2); and Sulfur Dioxide (SO_2); wherein the flue gas stream is at a first temperature during the flowing step; increasing NO_x removal efficiency of the at least one filter medium; wherein the increasing of the NO_x removal efficiency of the at least one filter medium comprises: adding ammonia (NH_3) in a concentration ranging from 0.0001% to 0.5% of the concentration of the flue gas stream; and increasing the temperature of the flue gas stream from the first temperature to a second temperature that exceeds the first temperature, wherein the second temperature is 10 °C to 100 °C higher than the first temperature; wherein a concentration of SO_2 in the flue gas stream is less than 12 ppm during the increasing of the NO_x removal efficiency of the at least one filter medium; wherein the method regenerates the at least one filter medium.

[5] The present disclosure also relates to a method of cleaning a flue gas stream, the method comprising: providing at least one filter medium, wherein the at least one filter medium comprises at least one catalyst material; flowing a flue gas stream transverse to a cross-section of the at least one filter medium, such that the flue gas stream passes through the cross section of the at least one filter medium from an upstream side of the filter medium

to a downstream side of the filter medium; wherein the flue gas stream comprises: NO_x compounds comprising: Nitric Oxide (NO), and Nitrogen Dioxide (NO_2); Sulfur Dioxide (SO_2); and Ammonia (NH_3); wherein the flue gas stream is at a first temperature during the flowing step; and maintaining a constant NO_x removal efficiency of the at least one filter medium; wherein the maintaining a constant NO_x removal efficiency of the at least one filter medium comprises increasing the temperature of the flue gas stream from the first temperature to a second temperature that exceeds the first temperature.

[5a] In another aspect, there is provided a method comprising: providing at least one filter medium, wherein the at least one filter medium comprises at least one catalyst material; flowing a flue gas stream transverse to a cross-section of the at least one filter medium, such that the flue gas stream passes through a cross section of the at least one filter medium from an upstream side of the filter medium to a downstream side of the filter medium; wherein the flue gas stream comprises: NO_x compounds comprising: Nitric Oxide (NO), and Nitrogen Dioxide (NO_2); Sulfur Dioxide (SO_2); and Ammonia (NH_3); wherein the flue gas stream is at a first temperature during the flowing step; and maintaining a constant NO_x removal efficiency of the at least one filter medium; wherein the maintaining a constant NO_x removal efficiency of the at least one filter medium comprises increasing the temperature of the flue gas stream from the first temperature to a second temperature that exceeds the first temperature, wherein the second temperature is 10 °C to 100 °C higher than the first temperature; wherein a concentration of SO_2 in the flue gas stream is less than 12 ppm during the maintaining a constant NO_x removal efficiency of the at least one filter medium; wherein the method cleans the flue gas stream.

[6] The present disclosure also relates to a method of cleaning a flue gas stream, the method comprising: providing at least one filter medium, wherein the at least one filter medium comprises at least one catalyst material; flowing a flue gas stream by a cross-section of the at least one filter medium, such that the flue gas stream is flowed parallel to a cross-section of the at least one filter medium from an upstream side of the filter medium to a downstream side of the filter medium; wherein the flue gas stream comprises: NO_x compounds comprising: Nitric Oxide (NO), and Nitrogen Dioxide (NO_2); Sulfur Dioxide (SO_2); and Ammonia (NH_3); wherein the flue gas stream is at a first temperature during the flowing step; maintaining a constant NO_x removal efficiency of the at least one filter medium; wherein the maintaining a constant NO_x removal efficiency of the at least one filter medium comprises increasing the temperature of the flue gas stream from the first temperature to a second temperature that exceeds the first temperature.

[6a] In another aspect, there is provided a method comprising: providing at least one filter medium, wherein the at least one filter medium comprises at least one catalyst material; flowing a flue gas stream by a cross-section of the at least one filter medium, such that the flue gas stream is flowed parallel to a cross-section of the at least one filter medium from an upstream side of the filter medium to a downstream side of the filter medium; wherein the flue gas stream comprises: NO_x compounds comprising: Nitric Oxide (NO), and Nitrogen Dioxide (NO_2); Sulfur Dioxide (SO_2); and Ammonia (NH_3); wherein the flue gas stream is at a first temperature during the flowing step; maintaining a constant NO_x removal efficiency of the at least one filter medium; wherein the maintaining a constant NO_x removal efficiency of the at least one filter medium comprises increasing the temperature of the flue gas stream from the first temperature to a second temperature that exceeds the first temperature, wherein the second temperature is 10 °C to 100 °C higher than the first temperature; wherein a concentration of SO_2 in the flue gas stream is less than 12 ppm during the maintaining a constant NO_x removal efficiency of the at least one filter medium; wherein the method cleans the flue gas stream.

[7] The present disclosure also relates to a method of cleaning a flue gas stream, the method comprising: providing at least one filter medium, wherein the at least one filter medium comprises at least one catalyst material; flowing a flue gas stream transverse to a cross-section of the at least one filter medium, such that the flue gas stream passes through the cross section of the at least one filter medium from an upstream side of the filter medium to a downstream side of the filter medium; wherein the flue gas stream comprises: NO_x compounds comprising: Nitric Oxide (NO), and Nitrogen Dioxide (NO_2); Sulfur Dioxide (SO_2); and Ammonia (NH_3); wherein the flue gas stream is at a first temperature during the flowing step; maintaining a NO_x removal efficiency of the at least one filter medium in an amount of at least 70% of an initial NO_x efficiency by increasing the temperature of the flue gas stream from the first temperature to a second temperature that exceeds the first temperature.

[7a] In another aspect, there is provided a method comprising: providing at least one filter medium wherein the at least one filter medium comprises at least one catalyst material; flowing a flue gas stream transverse to a cross-section of the at least one filter medium, such that the flue gas stream passes through a cross section of the at least one filter medium from an upstream side of the filter medium to a downstream side of the filter medium; wherein the flue gas stream comprises: NO_x compounds comprising: Nitric Oxide (NO), and Nitrogen Dioxide (NO_2); Sulfur Dioxide (SO_2); and Ammonia (NH_3); wherein the flue gas stream is at a first temperature during the flowing step; maintaining a NO_x removal efficiency of the at least one filter medium in an amount of at least 70% of an initial NO_x efficiency by increasing the temperature of the flue gas

stream from the first temperature to a second temperature that exceeds the first temperature, wherein the second temperature is 10 °C to 100 °C higher than the first temperature; wherein a concentration of SO_2 in the flue gas stream is less than 12 ppm during the maintaining a NO_x removal efficiency of the at least one filter medium; wherein the method cleans the flue gas stream.

[8] In some examples, the second temperature is at least 10 °C higher than the first temperature.

[9] In some examples, the second temperature is 10 °C to 100 °C higher than the first temperature.

CLAIMS

What is claimed is:

1. A method comprising:

providing at least one filter medium;

wherein the at least one filter medium comprises:

at least one catalyst material; and

ammonium bisulfate (ABS), ammonium sulfate (AS), or any combination thereof;

flowing a flue gas stream through or by the at least one filter medium;

wherein the flue gas stream comprises:

NO_x compounds comprising:

Nitric Oxide (NO), and

Nitrogen Dioxide (NO_2); and

Sulfur Dioxide (SO_2);

wherein the flue gas stream is at a first temperature during the flowing step;

increasing NO_x removal efficiency of the at least one filter medium;

wherein the increasing of the NO_x removal efficiency of the at least one filter medium comprises:

adding ammonia (NH_3) in a concentration ranging from 0.0001% to 0.5% of the concentration of the flue gas stream; and

increasing the temperature of the flue gas stream from the first temperature to a second temperature that exceeds the first temperature, wherein the second temperature is 10 °C to 100 °C higher than the first temperature;

wherein a concentration of SO_2 in the flue gas stream is less than 12 ppm during the increasing of the NO_x removal efficiency of the at least one filter medium;

wherein the method regenerates the at least one filter medium.

2. The method of claim 1, wherein the first temperature ranges from 180 °C to 230 °C.

3. The method of claim 1, wherein the second temperature ranges from 240 °C to 280 °C.

4. The method of claim 1, wherein the flue gas stream is flowed transverse to a cross-section of the at least one filter medium, such that the flue gas stream passes through a cross section of the at least one filter medium.

5. The method of claim 1, wherein the flue gas stream is not flowed transverse to a cross-section of the at least one filter medium, such that the flue gas stream does not pass through a cross section of the at least one filter medium.

6. The method of claim 1, wherein the flue gas stream is flowed perpendicular to a cross-section of the at least one filter medium.

7. The method of claim 1, wherein the flue gas stream is flowed parallel to a cross-section of the at least one filter medium.

8. The method of claim 1, wherein the at least one filter medium is disposed within at least one filter bag, wherein the at least one filter bag is housed within at least one filter bag housing, and wherein the at least one catalyst material is in a form of catalyst particles.

9. The method of claim 1, wherein the flue gas stream further comprises at least one of Oxygen (O_2), Water (H_2O), Nitrogen (N_2), Carbon Monoxide (CO), Sulfur Trioxide (SO_3), one or more hydrocarbons, or any combination thereof.

10. The method of claim 1, wherein the first temperature of the flue gas stream is increased to the second temperature continuously, so as to maintain the NO_x removal efficiency in an amount of at least 70% of an initial NO_x efficiency.

11. The method of claim 1, wherein the at least one filter medium comprises a porous protective layer and a porous catalytic layer, wherein the porous catalytic layer comprises the at least one catalyst material.

12. The method of claim 11, wherein the porous protective layer comprises a microporous layer, wherein the microporous layer comprises an expanded polytetrafluoroethylene (ePTFE) membrane.

13. The method of claim 11, wherein the at least one catalyst material comprises at least one of: Vanadium Monoxide (VO), Vanadium Trioxide (V_2O_3), Vanadium Dioxide (VO_2), Vanadium Pentoxide (V_2O_5), Tungsten Trioxide (WO_3), Molybdenum Trioxide (MoO_3), Titanium Dioxide (TiO_2), Silicon Dioxide (SiO_2), Aluminum Trioxide (Al_2O_3), Manganese Oxide (MnO_2), zeolites, or any combination thereof.

14. The method of claim 11, wherein the at least one catalyst material is adhered to the filter medium by at least one adhesive.

15. The method of claim 14, wherein the at least one adhesive is chosen from polytetrafluoroethylene (PTFE), fluorinated ethylene propylene (FEP), high molecular weight polyethylene (HMWPE), high molecular weight polypropylene (HMWPP), perfluoroalkoxy alkane (PFA), polyvinylidene fluoride (PVDF), vinylidene fluoride (THV), chlorofluoroethylene (CFE), or any combination thereof.

16. A method comprising:

providing at least one filter medium,

wherein the at least one filter medium comprises at least one catalyst material;

flowing a flue gas stream transverse to a cross-section of the at least one filter medium, such that the flue gas stream passes through a cross section of the at least one filter medium from an upstream side of the filter medium to a downstream side of the filter medium;

wherein the flue gas stream comprises:

NO_x compounds comprising:

Nitric Oxide (NO), and

Nitrogen Dioxide (NO_2);

Sulfur Dioxide (SO_2); and

Ammonia (NH_3);

wherein the flue gas stream is at a first temperature during the flowing step; and

maintaining a constant NO_x removal efficiency of the at least one filter medium;

wherein the maintaining a constant NO_x removal efficiency of the at least one filter medium comprises increasing the temperature of the flue gas stream from the first temperature to a second temperature that exceeds the first temperature, wherein the second temperature is 10 °C to 100 °C higher than the first temperature;

wherein a concentration of SO_2 in the flue gas stream is less than 12 ppm during the maintaining a constant NO_x removal efficiency of the at least one filter medium;

wherein the method cleans the flue gas stream.

17. The method of claim 16, wherein at least during the flowing step, the SO_2, NH_3, and NO_x compounds are present in an amount of at least 1 mg/m^3 based on a total volume of the flue gas stream.

18. A method comprising:

providing at least one filter medium,

wherein the at least one filter medium comprises at least one catalyst material;

flowing a flue gas stream by a cross-section of the at least one filter medium, such that the flue gas stream is flowed parallel to a cross-section of the at least one filter medium from an upstream side of the filter medium to a downstream side of the filter medium;

wherein the flue gas stream comprises:

NO_x compounds comprising:

Nitric Oxide (NO), and

Nitrogen Dioxide (NO_2);

Sulfur Dioxide (SO_2); and

Ammonia (NH_3);

wherein the flue gas stream is at a first temperature during the flowing step;

maintaining a constant NO_x removal efficiency of the at least one filter medium;

wherein the maintaining a constant NO_x removal efficiency of the at least one filter medium comprises increasing the temperature of the flue gas stream from the first temperature to a second temperature that exceeds the first temperature, wherein the second temperature is 10 °C to 100 °C higher than the first temperature;

wherein a concentration of SO_2 in the flue gas stream is less than 12 ppm during the maintaining a constant NO_x removal efficiency of the at least one filter medium;

wherein the method cleans the flue gas stream.

19. A method comprising:

providing at least one filter medium

wherein the at least one filter medium comprises at least one catalyst material;

flowing a flue gas stream transverse to a cross-section of the at least one filter medium, such that the flue gas stream passes through a cross section of the at least one filter medium from an upstream side of the filter medium to a downstream side of the filter medium;

wherein the flue gas stream comprises:

NO_x compounds comprising:

Nitric Oxide (NO), and

Nitrogen Dioxide (NO_2);

Sulfur Dioxide (SO_2); and

Ammonia (NH_3);

wherein the flue gas stream is at a first temperature during the flowing step;

maintaining a NO_x removal efficiency of the at least one filter medium in an amount of at least 70% of an initial NO_x efficiency by increasing the temperature of the flue gas stream from the first temperature to a second temperature that exceeds the first temperature, wherein the second temperature is 10 °C to 100 °C higher than the first temperature;

wherein a concentration of SO_2 in the flue gas stream is less than 12 ppm during the maintaining a NO_x removal efficiency of the at least one filter medium;

wherein the method cleans the flue gas stream.