According to an aspect of the present invention, there is provided a method of operating a closed loop superheated steam regeneration dehumidifier system, said dehumidifier system comprising a rotary desiccant wheel comprising a silica gel; a supply gas flow path for supplying a supply gas to an adsorption section of said rotary desiccant wheel defining thereby an upstream side and a front side of said rotary desiccant wheel, and a downstream side and a backside of said rotary desiccant wheel; and a closed regeneration loop for regenerating said rotary desiccant wheel using superheated steam; said closed regeneration loop comprising at least one means for circulating superheated steam in said closed regeneration loop, at least one steam superheater, at least one diversion flow path for diverting a flow of excess

superheated steam from said closed regeneration loop to at least one process element of interest, said at least one process element of interest being a heat exchanger or a heat driven cooling unit; said method comprising operating said closed regeneration loop at a regeneration operating temperature of said superheated steam from 110°C to 200°C; and diverting a flow of excess superheated steam from said closed regeneration loop to said at least one process element of interest.

The flow direction of said superheated steam is countercurrent to the flow direction of said supply gas, wherefore said superheated steam circulating in said closed regeneration loop will reach a regeneration section of said rotary desiccant wheel from said backside of said rotary desiccant wheel.

The flow direction of said

superheated steam is co-current to the flow direction of said supply gas, wherefore said superheated steam circulating in said closed regeneration loop will reach a regeneration section of said rotary desiccant wheel from said front side of said rotary desiccant wheel.

The above dehumidifier system further comprises a flush and heating flow path for supplying a first flush gas to a flush and heating section of said rotary desiccant wheel and/or a flush and cooling flow path for supplying a second flush gas to a flush and cooling section of said rotary desiccant wheel;

Said first flush gas and said second flush gas are the same, preferably the same as said supply gas.

Said flush and heating flow path, and said flush and cooling flow path, are connected to form a unified flush flow path; preferably connected to form a unified flush flow path either upstream from said rotary desiccant

wheel and/or downstream from said rotary desiccant wheel.

The above humidifier system comprises at least one further flush and heating flow path and/or at least one further flush and cooling flow path.

Said rotary desiccant wheel comprises a combination of adsorbents, preferably of silica gel and zeolite as a mixture; or as alternating layers of two or more of said adsorbents, preferably alternating layers of silica gel and zeolite.

The regeneration operating steam pressure of said superheated steam is from 1 bar to 5 bars, preferably from 1 bar to 3 bars, more preferably from 1 bar to 2 bars, most preferable from 1.05 bars to 1.5 bars.

The temperature of said supply gas upon entry into said rotary desiccant wheel is from 5°C to 100°C, preferably from 10°C to 60°C, preferably from 20°C to 50°C, preferably from 30°C to 40°C.

The above dehumidifier system further comprises at least one underpressure section.

Excess superheated steam from said closed regeneration loop for superheated steam regeneration of said rotary desiccant wheel is diverted from said closed regeneration loop along said diversion flow path to said at least one process element of interest, said at least one process element of interest being a heat exchanger, preferably a condenser, comprised in said closed regeneration loop, preferably said heat exchanger arranged in said closed regeneration loop between said at least one means for circulating superheated steam and said steam superheater.

The above dehumidifier system further comprises in said diversion flow path at least one compressor for compressing in at least on compression step said excess superheated steam prior to entering said heat exchanger.

Excess superheated steam from a closed regeneration loop for superheated steam regeneration of a rotary desiccant wheel is diverted from said closed regeneration loop along a diversion flow path to at least one heat driven cooling unit located either upstream or downstream of said rotary desiccant wheel in a gas flow path, preferably located in said supply gas flow path.

Said dehumidifier system comprising a first dehumidifier system, said first dehumidifier system comprising a closed regeneration loop for regenerating a rotary desiccant wheel using superheated steam according to any of the preceding embodiments, and at least a second dehumidifier system, said second dehumidifier system comprising at least one second rotary desiccant wheel, said at least one second dehumidifier system not comprising a closed regeneration loop for regenerating said at least one second rotary desiccant wheel using superheated steam, wherein said first dehumidifier system and said at least a

CLAIMS:

1. A method of operating a closed loop superheated steam regeneration dehumidifier system, said dehumidifier system comprising

- a rotary desiccant wheel comprising a silica gel;
- a supply gas flow path for supplying a supply gas to an adsorption section of said rotary desiccant wheel defining thereby an upstream side and a front side of said rotary desiccant wheel, and a downstream side and a backside of said rotary desiccant wheel;

- a closed regeneration loop for regenerating said rotary desiccant wheel using superheated steam;
said closed regeneration loop comprising

- at least one means for circulating superheated steam in said closed regeneration loop,
- at least one steam superheater,
- at least one diversion flow path for diverting a flow of excess superheated steam from said closed regeneration loop to at least one process element of interest, said at least one process element of interest being a heat exchanger or a heat driven cooling unit;

said method comprising:

- operating said closed regeneration loop at a regeneration operating temperature of said superheated steam from 110°C to 200°C; and
- diverting a flow of excess superheated steam from said closed regeneration loop to said at least one process element of interest.

2. A method of operating a closed loop superheated steam regeneration dehumidifier system according to claim 1, wherein said dehumidifier system is operated at a regeneration operating temperature of said superheated steam from 120°C to 180°C, most preferably from 130°C to 150°C.

3. A method of operating a closed loop superheated steam regeneration dehumidifier system according to claims 1 or 2, wherein the regeneration operating steam pressure of said superheated steam is from 1 bar to 5 bars, preferably from 1 bar to 3 bars, more preferably from 1 bar to 2 bars, most preferable from 1.05 bars to 1.5 bars.

4. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 1 to 3, wherein the temperature of said supply gas upon entry into said rotary desiccant wheel is from 5°C to 100°C, preferably from 10°C to 60°C, preferably from 20°C to 50°C, preferably from 30°C to 40°C.

5. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 1 to 4, wherein the flow direction of said superheated steam is countercurrent to the flow direction of said supply

gas, wherefore said superheated steam circulating in said closed regeneration loop will reach a regeneration section of said rotary desiccant wheel from said backside of said rotary desiccant wheel.

6. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 1 to 5, wherein said dehumidifier system further comprises a flush and heating flow path for supplying a first flush gas to a flush and heating section of said rotary desiccant wheel and/or a flush and cooling flow path for supplying a second flush gas to a flush and cooling section of said rotary desiccant wheel.

7. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 1 to 6, wherein said first flush gas and said second flush gas are the same, preferably the same as said supply gas.

8. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 6 or 7, wherein said flush and heating flow path, and said flush and cooling flow path, are connected to form

a unified flush flow path; preferably connected to form a unified flush flow path either upstream from said rotary desiccant wheel and/or downstream from said rotary desiccant wheel.

9. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 1 to 8, wherein said dehumidifier system comprises at least one further flush and heating flow path and/or at least one further flush and cooling flow path.

10. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 1 to 9, wherein said rotary desiccant wheel comprises a combination of adsorbents, preferably of silica gel and zeolite as a mixture; or as alternating layers of two or more of said adsorbents, preferably alternating layers of silica gel and zeolite.

11. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 1 to 10, wherein said dehumidifier system further comprises at least one underpressure section.

12. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 1 to 11, wherein said first dehumidifier system comprises a closed regeneration loop for regenerating a rotary desiccant wheel using superheated steam, and at least a second dehumidifier system, said second dehumidifier system comprising at least one second rotary desiccant wheel, said at least one second dehumidifier system not comprising a closed regeneration loop for regenerating said at least one second rotary desiccant wheel using superheated steam, wherein said first dehumidifier system and said at least a second dehumidifier system are arranged sequentially on said supply gas flow path, preferably arranged sequentially with said first dehumidifier system arranged upstream of said at least a second dehumidifier system on said supply gas flow path.

13. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 1 to 12, wherein excess superheated steam from said closed regeneration loop for superheated steam regeneration of a rotary desiccant wheel is diverted from said closed regeneration loop along a diversion flow path to at least one heat exchanger located either upstream or downstream of said rotary desiccant wheel in said supply gas flow path.

14. A method of operating a closed loop superheated steam regeneration dehumidifier system according to any of the claims 1 to 13, wherein excess superheated steam from said closed regeneration loop for superheated steam regeneration of said rotary desiccant wheel is diverted from said closed regeneration loop along said diversion flow path to said at least one process element of interest, said at least one process element of interest being a heat exchanger, preferably a condenser, comprised in said closed regeneration loop, preferably said heat exchanger arranged in said closed regeneration loop between said at least one means for circulating superheated steam and said steam superheater; and wherein said diversion flow path comprises at least one compressor for compressing in at least on compression step said excess superheated steam prior to entering said heat exchanger.