heating means comprises radiative sheeting, generally consisting of resistance based heating material, placed coaxially around the reactor tube, the surface area of the sheeting facing the outer surface area of the reactor tube defining an inner surface area of the electrical heating means;(c) the inner surface area of the heating means covers at least 60%, preferably at least 70%, more preferably at least 80%, and particularly at least 95%, of the reactor tube outer surface area; and (d) the distance between the reactor tube and the heating means is selected such that the ratio between the inner surface area of the electrical heating means to the reactor tube outer surface area is in the range of 0.7 to 3.0.

Electrically heating a process in a reactor demands a heat-flux and temperature profile. In many applications the heat-flux is larger – and the temperature in the reactor is lower - at the inlet of the reactor, where the process flow enters, whereas towards the outlet the heat-flux is lower - whilst having higher temperature in the reactor. The present invention can accommodate this requirement to optimize the conversion of the desired reactions.

The present disclosure also relates to a furnace, comprising within the furnace a reactor according to the present disclosure, one or more reactor tubes of said reactor having an entrance and exit outside of the furnace; and one or more inspection ports in the furnace wall, each of which inspection ports being placed opposite to a reactor tube.

Further, the present disclosure relates to a method of performing a gas conversion process at high temperatures, comprising introducing at least one gaseous reactant into a reactor according to the present

capable of operating at relatively high temperature (up to ~1300 °C). Preferably, Fecralloy heating materials are used in an oxidizing atmosphere (> 200 ppm O_2) to maintain an Al_2O_3 protective layer on the elements. The highest temperature that can be achieved in the reactor configuration of the present disclosure is mainly limited by the type of heating materials that is used. The present reactor is suitable for reactions at temperatures ranging from 400 to 1400 °C, preferably from 500 to 1200 °C, even more preferred from 600 to 1100 °C.

According to the invention, preferably, the reactor tube is surrounded by electrical heating means in the form of radiative sheeting that is divided into at least two, more preferred at least three, segments which are placed lengthwise along the reactor tube, each of which segments being connected to a separate power control. This allows temperature control along the length of the reactor. The number of segments is dependent on the desired level of temperature control. The distance between the segments is selected to be as short as possible, but allowing for expansion, which is different for each segment.

In another preferred embodiment according to the invention, the heating means surrounding the reactor tube comprises, and preferably is, a radiative sheeting placed coaxially around / in parallel with the reactor tube, while leaving an opening along the length of the reactor tube with a size that at least matches the diameter of the reactor tube. This allows easy maintenance and handling of the heater sheets. Sheets can easily be inserted and removed when open on one side.

Further, in another preferred embodiment according to the invention, the heating means is a radiative sheeting consisting of panels of the radiative heating material,

configuration as the heat-flux to the reactor tubes can be controlled over the reactor tube length. However, this side fired burner configuration is not widely applied in practice as it has several disadvantages. In case of gas-fired heating, the side fired configuration requires many burners and the heat flux control results in an increased complexity of the combustion control. The heat flux herein is defined as the flow of energy per unit of area per unit of time (in SI its units are Watts per square meter (W/m^2)).

When using electrical heating, the above-mentioned disadvantages of side gas-fired heating are no longer present and the process advantages of having a more accurate duty control over the length of the reactor tube can be accomplished. For example, higher outlet temperatures can be achieved, thereby improving conversion.

The use of reactors according to the present disclosure can be scaled up to industrial scale. The sizes of conventional reactor tubes used in industrial scale gas-conversion reactors are in the order of 120-140 mm outside diameter and 12 meter length. Notwithstanding that, many different process tube configurations may be applied to suit the need of the process. For electrical heating, given the increased controllability of heat fluxes and temperature optimization of the reactor tube configuration may be needed, for example resulting in a more compact design. Suitably, in the present reactor the size of a reactor tube is at least similar to the conventional reactor tube size.

For many industrial gas conversion reactions, preferably, the furnace comprises at least ten or more

C L A I M S

1. An electrically heated reactor having an outer surface area, an inlet and an outlet, wherein
(a) the reactor is a reactor tube surrounded by electrical heating means at a certain distance;
(b) the electrical heating means comprises radiative sheeting placed coaxially around the reactor tube, the surface area of the sheeting facing the outer surface area of the reactor tube defining an inner surface area of the electrical heating means;
(c) the inner surface area of the heating means covers at least 60% of the reactor tube outer surface area;
and
(d) the distance between the reactor tube and the heating means is selected such that the ratio between the inner surface area of the electrical heating means to the reactor tube outer surface area is in the range of 0.7 to 3.0.
2. A reactor according to claim 1, wherein the radiative sheeting is divided into at least two segments which are placed lengthwise along the reactor tube, each of which segments being connected to a separate power control.
3. A reactor according to any one of the preceding claims, wherein the radiative sheeting comprises NiCr or FeCrAl based resistance heating materials.
4. A reactor according to any one of the preceding claims, wherein the heating means is a radiative sheeting placed coaxially around the reactor tube, while leaving an opening along the length of the reactor tube with a size that matches the diameter of the reactor tube.

5. A reactor according to any one of the preceding claims, wherein the heating means is a radiative sheeting consisting of panels of the radiative heating material.

6. A furnace, comprising within the furnace a reactor according to any one of claims 1 to 5, one or more reactor tubes of said reactor having an entrance and exit outside of the furnace; and one or more inspection ports in the furnace wall, each of which inspection ports being placed opposite to a reactor tube.

7. A method of performing a gas conversion process at high temperatures, comprising introducing at least one gaseous reactant into a reactor of any one of claims 1-5, electrically heating the reactor to a temperature in the range of 400 - 1400 °C through radiative heating of the heating means, and performing the high temperature gas conversion.

8. A method of performing a gas conversion process of claim 7, wherein the gas conversion process comprises producing a synthesis gas by means of steam methane reforming, dry CO2 reforming, reverse water-gas shift or a combination thereof, comprising the steps of:

   i. Providing hydrocarbons and steam and/or CO_2 to the reactor according to any one of claims 1-5, such that the reaction mixture enters the at least one reactor tube;

   ii. Maintaining the reactor at a temperature of at least 400 °C by providing electrical energy to the heating means;

   iii. Allowing the hydrocarbons and steam to be converted into hydrogen and carbon monoxide; and

   iv. Obtaining from the reactor a synthesis gas stream.

9. The method of claim 7 or 8, comprising controlling the temperatures/heat fluxes in different segments of the

heating means, wherein the heating means comprises at least two segments, wherein each segment has its own power control unit that is regulated to achieve a desired heat flux profile over the surface of the at least one reactor.