CLAIMS

1. Method of improving an endothermic process that takes place in a furnace containing tubes being filled with a catalyst for chemical conversion of a gaseous feed and positioned vertically in rows inside the furnace, burners being fed with primary and secondary fuel streams and oxidizer stream and mounted in rows with rows of inner burners placed between two rows of tubes and rows of outer burners placed between a row of tubes and a side wall parallel to the rows of tubes, with heat being transferred from the burners to the tubes and with flow rates associated, where the method improves the homogenization of temperatures of the tubes by throttling part of the burners,

characterized in that the method comprises the steps of:

step a) optionally calibrating a simplified physical model of step c3) by measuring one or more real tube temperature for at least a tube impacted by the throttling of a burner in standard and in throttled state,

step b) acquiring information on the real tube temperature for the tubes present in the furnace with all the burners present in the furnace under standard non-throttled conditions,

step c) getting a map of burners to throttle including:

c1) choosing at least one parameter representative of the performances of the furnace with a target of improvement,

c2) choosing at least one or more power ratio for the burner throttling,

c3) utilizing the information of step b) and the simplified physical model of the impact of throttling the burner on tube skin temperature for the tubes in the furnace to individually know the impact of the throttling of the burner on the chosen target of step c1), and individually identifying the burners to throttle,

c4) getting the map of burners of the furnace where the burners to throttle are individually identified,

step d) throttling the burners according to the map got in step c4),

characterized in that the simplified physical model of the impact of the burner throttling on the tube skin temperature is based on the following rules 1) to 3) of behavior:

1) throttling the burner impacts significantly the two closest rows of tubes, the two closest rows of tubes being on a same side for an outer burner and one on each side of the

burner for an inner burner; throttling the outer burner has a higher impact on the closest row of tube than on the second row whereas the inner burner throttling distributes impact on the closest rows of tubes on both sides; within any of the impacted rows, the throttling of the burner has the highest impact on the closest tubes, the impact on the tubes decreasing rapidly while moving off from the throttled burner, the number of tubes impacted by the throttling of the burner is estimated at 4xNtubes/Nburners, for the impacted tubes the tube skin temperature variation is proportional to distance from the throttled burner

with Ntubes = number of tubes in the row, and Nburners = number of burners in the row;

2) the impacts of the throttled burners on the tube skin temperature cumulate;

3) the tube skin temperatures variations are proportional to the power ratio τ, with τ being:

$$\tau = \frac{\mathrm{P\ non-throttled} + \Delta \mathrm{P}}{\mathrm{P\ non-throttled}}$$

where $\mathrm{P\ non-throttled}$ is power of the burner in standard operational mode and $\Delta \mathrm{P}$ is power variation induced by the throttling with $\Delta \mathrm{P} < 0$ when the burner power has decreased due to the throttling of the burner and $\Delta \mathrm{P} > 0$ when the burner power increase due to redistribution of the power among non-throttled burners in the furnace.

2. Method according to claim 1 characterized in that the one or more parameters of step c1) is chosen among the following: Maximum Tube Skin Temperature, Tube Skin Temperature Spread, Syngas Collector Temperature Spread with the target of improvement being a reduction of a parameter value.

3. Method according to claim 1 or 2 characterized in that in the step c3), the simplified physical model is combined with an optimization algorithm which is either an in house optimization algorithm or algorithms for optimization known in the art, such as a black box optimization algorithms.

4. Method according to any of the preceding claims characterized in that the throttling of the burners is obtained by partially closing at least a valve installed on at least one of the fuel

streams or the oxidizer stream preferably on the fuel streams and more preferably on the secondary fuel stream.

5. Method according to any of the preceding claims characterized in that the power ratio $\tau\%$ of the throttled burner is between 90% and 50%, preferably between 80% and 60% .

6. Method according to any of the preceding claims characterized in that the information on the real tube temperature of step b) is the tube skin temperature, being preferably obtained by means of a thermocouple or a pyrometer or an Infrared camera, or deduced from syngas collector temperature being preferably obtained by means of a thermocouple.

7. Method according to any of the preceding claims characterized in that the method comprises the calibration step a) where the real tube temperature measurements are performed for the one or more tubes impacted by the throttled burner, at least for the tube in front of the burner in the non-throttled and in the throttled conditions, with the burner being preferably the outer burner.

8. Furnace containing reforming tubes being filled with a catalyst for the chemical conversion of a gaseous feed and being positioned vertically in rows inside the furnace, burners being mounted in rows with rows of inner burners placed between two rows of tubes and rows of outer burners placed between a row of tubes and a side wall parallel to the rows of tubes, with heat being transferred from the burners to the tubes and with flow rates associated characterized in that part of the burners are individually throttled according to the map got by the method of any of the claims 1 to 7.