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METHOD OF OPERATING A BURNER FOR THE PARTIAL OXIDATION OF HYDROCARBONS TO SYNTHESIS GAS

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U.S. Cl. 252—373 3 Claims

ABSTRACT OF THE DISCLOSURE

A mixture of hydrocarbon fuel and steam is introduced into the reaction zone of a synthesis gas generator by way of the annulus of an annular burner. Simultaneously, a mixture of oxygen and steam in the amount of about 0.5 to 5.5 weight percent steam (basis oxygen) is introduced into said reaction zone through the concentric inner conduit of the burner. Then, by partial oxidation of the hydrocarbon fuel in the reaction zone, synthesis gas i.e. a mixture comprising carbon monoxide and hydrogen, is produced.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a process for the generation of synthesis gas, i.e. carbon monoxide and hydrogen. In one of its more specific aspects, it concerns a method for operating an annular burner for the preparation of synthesis gas by the partial oxidation of hydrocarbon fuels.

Description of the prior art

The temperatures prevailing in the partial combustion of hydrocarbons with oxygen or oxygen-enriched air in the presence of steam and/or carbon dioxide place particular requiremnts on the construction and the material of a burner. In the partial combustion of hydrocarbons, temperatures between 1100° C. (2012° F.) and 1500° C. (2732° F.) are generated. At these temperatures the reactivity of oxygen on the metals from which the burners are made is extremely high. It is therefore important to choose a burner arrangement in which the high temperatures do not occur in the immediate neighborhood of the burner nozzle. This was attempted in the prior art by first reacting the hydrocarbons with the oxygen outside of the burner tip. For example, a concentric arrangement of two tubes was used as the burner with the hydrocarbons being mixed with the steam in the outer tube and the oxygen being added through the inner tube. However, further difficulties with such an arrangement occurred. For example, turbulent flow developed at the burner nozzle, and the reaction moved back to the exhaust port, causing burner material to overheat.

It was then sought to avoid this and other difficulties by providing a device for cooling the burner tip. However, by such means only the outer tube could be protected, and the inner tube, which was still subject to oxygen attack, had to be designed so that it could be rapidly replaced.

Thus, by these preventive measures it was possible to avoid an erosion or oxygen attack on the outer burner tube thereby considerably increasing its operating life. However, obviating the corrosion of the inner tube conducting the oxygen was not achieved, and corrosion of the inner tube was perceptible by a relatively rapid shortening rate, e.g., 0.5 to 1.0 mm./day (0.02 to 0.04 inch/day). If the distance from the end of the inner tube to the burner orifice became too great, then those velocities for the individual reaction components were no longer obtained which were necessary to hold the reaction outside the burner orifice. A flashback of the flame in the burner orifice would then occur which led to a still more rapid corrosion of the burner materials. When this took place, cooling the burner tip no longer provided adequate protection for the outer tube. Consequently, this burning loss required periodic replacement of the inner tube.

SUMMARY

It has now been discovered that one avoids the disadvantages of the earlier method of operation in the use of a burner comprising a plurality of concentrically arranged tubes for the preparation of synthesis gas by the partial oxidation of hydrocarbon fuels under elevated pressure and temperature if a mixture of hydrocarbon fuel and most of the required steam or carbon dioxide or both the steam plus carbon dioxide are introduced into the reaction zone of a synthesis gas generator through an outer tube or annulus of the burner, and the oxygen or the oxygen containing gas plus a comparatively small amount of steam is introduced through the concentric inner tube of the burner. Preferably, about 0.5 to 5.5 weight percent of steam (basis weight of oxygen) is mixed with the oxygen and passed through the center pipe of the annular burner.

It is therefore a principal object of this invention to provide an improved process for operating an annular burner for producing synthesis gas.

Another object of this invention is to provide a continuous process by which a hydrocarbon fuel and oxygen may be economically and efficiently combined and reacted for the production of synthesis gas.

A still further object of this invention is to provide an improved process for producing synthesis gas in which the life of the burner is extended.

These and other objects will be obvious to those skilled in the art from the following disclosure.

DESCRIPTION OF THE INVENTION

The method of the invention is generally applicable in burner constructions known for the partial oxidation of hydrocarbon fuels with oxygen. These burners consist in general of a plurality of concentrically arranged tubes. In a preferred embodiment of my invention, the burner comprises an outer conduit, an inner conduit, and an annular passage between said inner and outer conduits. The hydrocarbon fuel, optionally admixed with substantially all of the steam or CO_2 or both if required for the reaction, is passed through the annular passage of the burner while the oxygen required for the partial combustion plus a relatively smaller amount of steam is passed through the inner tube. The requisite steam which is added to the oxygen in the inner conduit can be taken from the main quantity of steam which is ordinarily mixed with the charged hydrocarbon fuel, without requiring an increase in the total amount of steam supplied to the generator. Steam in the amount of about 0.5 to about 5 weight percent (basis weight of free oxygen supplied to the burner, and preferably 1.0 to 3.0%) is admixed with the oxygen. This method of operation also makes possible the easy flushing of the inner tube of the burner with steam, either during or after shutdown. Examples of suitable burners are described in German Pat. 1,061,303 (U.S. Pat. 2,928,-459) and German Pat. 1,080,079 (U.S. Pat. 2,925,460).

Suitable hydrocarbon charge stocks include gaseous and liquid hydrocarbon fuels, e.g., methane, gasoline, but particularly crude oil or heavy fuel oil. These hydrocarbon fuels and optionally steam are mixed in a suitable device and, in certain cases after preheating to 250° to 500° C., (482 to 932° F.), the mixture is passed through the annulus of the burner. The oxygen required for the heating and partial combustion is suitably preheated, mixed with steam, and is passed through the inner tube of the burner. In place of substantially pure oxygen (95 mole percent O_2 or more) one can also use an oxygen-enriched air. The relatively small amount of steam that is mixed with the oxygen according to this invention does not affect the pressure (1 to 350 atmospheres) and the temperature (about 2000 to 3000° F.) in the reaction zone of the synthesis gas generator.

The method can also be carried out so that the steam is introduced through a branch line discharging into the burner directly before the introduction of the oxygen supply line. In this manner it is possible to feed the steam to the reaction zone only after successful ignition. The preventive measure of the present invention is possible without great expense and can therefore also be incorporated relatively easily into existing plants.

The synthesis gas generator consists of a conventional compact unpacked free-flow noncatalytic refractory lined steel pressure vessel of the type described in U.S. Pat. 2,809,104 issued to Dale M. Strasser et al.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The following example is offered as a better understanding of the present invention, but the invention is not to be construed as limited thereto.

In run 1, 13,700 kg./hr. (30,140 lbs./hr.) of 17° API heavy fuel oil having a gross heating value of about 18,500 B.t.u./lb. are mixed in a preheat coil with 6,800 kg./hr. (14,960 lbs./hr.) of steam at a pressure of 85 atm. and a temperature of 320° C. (608° F.). The mixture of oil and steam is then passed through the annulus of an annular burner and into the reaction zone of a conventional free-flow synthesis gas generator. The annular burner comprises center and outer conduits with an annulus in-between, as shown in FIGS. 1 to 3 of U.S. Pat. 2,928,460.

At the same time, a mixture of 11,200 N cu. m./hr. (418,000 s.c.f./hr.) of oxygen at a temperature of 160° C. (320° F.) and 300 kg./hr. (660 lbs./hr.) of steam is simultaneously passed through the center conduit of the annular burner. This represents about 1.8 weight percent of steam based on the oxygen.

The reactants are reacted in the reaction zone following the burner at a temperature of 1350° C. (2462° F.). 49,000 N cu. m./hr. (1,830,000 s.c.f./hr.) of synthesis gas is produced having the following analysis in mole percent dry basis 47.7% H_2; 45.5% CO; 5.1% CO_2 and 1.7% inerts. The burner operates trouble free and after an operating period of 30 days the center conduit shows no dimensional change at the burner nozzle.

For comparative purposes, run 2 is made under the same conditions as described previously for run 1 but without adding steam to the oxygen. After 25 days of operating, the center conduit may be observed to have shortened about 3 to 15 mm. (0.12 to 0.60 inch.) This reduction in length of the center conduit leads to irregularities in the burning, for example short term quick changes in pressure drop in the burner.

The process of the invention has been described generally and by examples, with reference to annular burners and materials of particular design and composition for purposes of clarity and illustration only. It will be apparent to those skilled in the art from the foregoing that various modifications of the process, materials, and apparatus disclosed herein can be made without departure from the spirit of the invention.

We claim:

1. In a process for the preparation of gaseous mixtures comprising carbon monoxide and hydrogen from a stream of hydrocarbon fuel and a stream of substantially pure oxygen wherein said streams are admitted into a reaction zone of a free-flow noncatalytic partial oxidation gas generator by passing said streams through an annular burner comprising concentric center and outer conduits each with a nozzle tip and an annular passage in-between said conduits and wherein said stream of substantially pure oxygen is passed through said center conduit and said stream of hydrocarbon fuel optionally in admixture with a temperature moderator is passed through said annular passage, and said streams are reacted by partial oxidation in said reaction zone at a temperature in the range of about 2000 to 3000° F. and a pressure in the range of about 1 to 350 atmosphere, said reaction being one which in the absence of supplemental steam added to said substantially pure oxygen would result in relatively rapid erosion and oxygen attack of the nozzle tip of said central conduit, the improvement which comprises mixing said stream of substantially pure oxygen with about 0.5 to 5.5 weight percent of steam (basis weight of free oxygen supplied to the burner) to produce a mixture of steam and substantially pure oxygen, introducing said mixture into said reaction zone by way of said center conduit, and simultaneously passing a stream of said hydrocarbon fuel optionally in admixture with said temperature moderator through said annular passage, wherein said materials are reacted without causing substantial erosion and oxygen attack to the nozzle tip of said central conduit.

2. The process of claim **1** wherein said temperature moderator is selected from the group consisting of H_2O, CO_2 and mixtures thereof.

3. The process of claim **1** wherein said hydrocarbon fuel is selected from the group consisting of methane, gasoline, crude oil, and heavy fuel oil.

References Cited

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U.S. Cl. X.R.

23—281; 48—95, 215

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CERTIFICATE OF CORRECTION

Patent No. 3,738,940 Dated June 12, 1973

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It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1 after line 9 Insert the following:

--Foreign Application Priority
Data: February 5, 1969
Germany P 19 05 604.3--

Signed and Sealed this

twenty-third **Day of** *December 1975*

[SEAL]

Attest:

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