cracking reaction therein, wherein a monoolefin-containing stream is conveyed to the cracking furnace for cracking reaction through at least one of the following modes:

Mode A: mixing a first mixture with the liquid feed stock, heating the mixed resultant in the convection section, and then feeding it to the radiant section for cracking reaction;

Mode B: feeding the monoolefin-containing stream or the first mixture to an inlet of the radiant section, and mixing the same with material from the convection section; and

Mode C: feeding the monoolefin-containing stream or the first mixture to an outlet of the radiant section, and mixing the same with products of a first cracking reaction for a second cracking reaction.

The monoolefin-containing stream is a hydrocarbon stream containing at least one selecting from a group consisting of ethylene, propylene, butene, pentene and hexene, the sum content of ethylene, propylene, butene, pentene and hexaene accounting for more than 10% by weight of the hydrocarbon stream.

The first mixture is a mixture comprising the monoolefin-containing stream and at least one of steam and hydrogen.

Specifically, in Mode A of the present disclosure, the first mixture is mixed with the liquid feed stock inside or outside the convection section, preferably outside the convection section, before entering into a hybrid heating segment of the convection section. In Mode C according to the present disclosure, the outlet of the radiant section means an area adjacent the outlet in the radiant section.

It can be easily understood that in the above Modes B and C, the monoolefin-containing stream (or the monoolefin stream in the first mixture) is fed

In Mode B according to the present disclosure, the monoolefin-containing stream is fed into the cracking apparatus from the inlet of the radiant section. Therefore, the addition of olefins would not bring about coke in the convection section of the cracking furnace. In the radiant section of the cracking furnace, olefins would co-crack with the liquid feed stock.

In Mode C according to the present disclosure, the monoolefin-containing stream is fed into the cracking apparatus from the outlet of the radiant section. Therefore, the addition of olefins would not bring about formation of coke in the convection section of the cracking furnace, either. At the outlet of the radiant section of the cracking furnace, olefins would co-crack with the products of the first cracking reaction from the radiant section.

In one specific embodiment, the monoolefin-containing stream of the present disclosure is a hydrocarbon stream with the sum content of ethylene, propylene, butene, pentene and hexaene accounting for more than 30% by weight of the hydrocarbon stream, preferably a hydrocarbon stream with the sum content of butene, pentene and hexaene accounting for more than 50% by weight of the hydrocarbon stream, and more preferably a hydrocarbon stream with the sum content of 1-butene and 2-butene accounting for more that 50% by weight of the hydrocarbon stream. Through experiments, the inventor of the present disclosure finds that when the monoolefin-containing material added to the cracking furnace comprises a certain amount of 1-butene and 2-butene, the monoolefin-containing material would co-crack with the liquid feed stock and/or the products of the first cracking reaction generated in the radiant section, so that a relatively high yield of butadiene can be obtained.

Preferably, in Mode A, a mixture of the monoolefin-containing stream and steam is preheated to a temperature in a range from 480 to 560 °C, preferably in a range from 500 to 540 °C in the convection section before being mixed with the liquid feed stock. In the above solution, more preferably, the liquid feed stock is preheated to a

cracking reaction therein, wherein a monoolefin-containing stream is conveyed to the cracking furnace for cracking reaction through at least one of the following modes:

Mode A: mixing a first mixture with the liquid feed stock, heating the mixed resultant in the convection section, and then feeding it to the radiant section for cracking reaction;

Mode B: feeding the monoolefin-containing stream or the first mixture to an inlet of the radiant section, and mixing the same with material from the convection section; and

Mode C: feeding the monoolefin-containing stream or the first mixture to an outlet of the radiant section, and mixing the same with products of a first cracking reaction for a second cracking reaction.

The monoolefin-containing stream is a hydrocarbon stream containing at least one selecting from a group consisting of ethylene, propylene, butene, pentene and hexene, the sum content of ethylene, propylene, butene, pentene and hexene accounting for more than 10% by weight of the hydrocarbon stream.

The first mixture is a mixture comprising the monoolefin-containing stream and at least one of steam and hydrogen.

Specifically, in Mode A of the present disclosure, the first mixture is mixed with the liquid feed stock inside or outside the convection section, preferably outside the convection section, before entering into a hybrid heating segment of the convection section. In Mode C according to the present disclosure, the outlet of the radiant section means an area adjacent the outlet in the radiant section.

It can be easily understood that in the above Modes B and C, the monoolefin-containing stream (or the monoolefin stream in the first mixture) is fed

In Mode B according to the present disclosure, the monoolefin-containing stream is fed into the cracking apparatus from the inlet of the radiant section. Therefore, the addition of olefins would not bring about coke in the convection section of the cracking furnace. In the radiant section of the cracking furnace, olefins would co-crack with the liquid feed stock.

In Mode C according to the present disclosure, the monoolefin-containing stream is fed into the cracking apparatus from the outlet of the radiant section. Therefore, the addition of olefins would not bring about formation of coke in the convection section of the cracking furnace, either. At the outlet of the radiant section of the cracking furnace, olefins would co-crack with the products of the first cracking reaction from the radiant section.

In one specific embodiment, the monoolefin-containing stream of the present disclosure is a hydrocarbon stream with the sum content of ethylene, propylene, butene, pentene and hexene accounting for more than 30% by weight of the hydrocarbon stream, preferably a hydrocarbon stream with the sum content of butene, pentene and hexene accounting for more than 50% by weight of the hydrocarbon stream, and more preferably a hydrocarbon stream with the sum content of 1-butene and 2-butene accounting for more that 50% by weight of the hydrocarbon stream. Through experiments, the inventor of the present disclosure finds that when the monoolefin-containing material added to the cracking furnace comprises a certain amount of 1-butene and 2-butene, the monoolefin-containing material would co-crack with the liquid feed stock and/or the products of the first cracking reaction generated in the radiant section, so that a relatively high yield of butadiene can be obtained.

Preferably, in Mode A, a mixture of the monoolefin-containing stream and steam is preheated to a temperature in a range from 480 to 560 $^{\circ}$C, preferably in a range from 500 to 540 $^{\circ}$C in the convection section before being mixed with the liquid feed stock. In the above solution, more preferably, the liquid feed stock is preheated to a

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Claims

1. A steam cracking process, comprising heating a liquid feed stock in a convection section of a cracking furnace and subsequently conveying the material to a radiant section of the cracking furnace for cracking reaction therein, wherein a monoolefin-containing stream is conveyed to the cracking furnace for cracking reaction through at least one of the following modes:

Mode A: mixing a first mixture with the liquid feed stock, heating the mixed resultant in the convection section, and then feeding it to the radiant section for cracking reaction;

Mode B: feeding the monoolefin-containing stream or the first mixture to an inlet of the radiant section, and mixing the same with material from the convection section; and

Mode C: feeding the monoolefin-containing stream or the first mixture to an outlet of the radiant section, and mixing the same with products of a first cracking reaction for a second cracking reaction;

wherein the monoolefin-containing stream is a hydrocarbon stream containing at least one selecting from a group consisting of ethylene, propylene, butene, pentene and hexene, the sum content of ethylene, propylene, butene, pentene and hexaene accounting for more than 10% by weight of the hydrocarbon stream; and

wherein the first mixture is a mixture comprising the monoolefin-containing stream and at least one of steam and hydrogen.

2. The process according to claim 1, wherein in Mode A, the first mixture is mixed with the liquid feed stock outside the convection section before entering into a hybrid heating segment of the convection section.

3. The process according to claim 2, wherein the first mixture is first heated in a diluted steam superheating section of the convection section before being mixed with the liquid feed stock and then entering into the hybrid heating segment of the convection section.

4. The process according to any one of claims 1 to 3, wherein the monoolefin-containing stream is a hydrocarbon stream with the sum content of ethylene, propylene, butene, pentene and hexaene accounting for more than 30% by weight of the hydrocarbon stream, preferably a hydrocarbon stream the sum content of butene, pentene and hexaene accounting for more than 50% by weight of the hydrocarbon stream, and more preferably a hydrocarbon stream the sum content of 1-butene and 2-butene accounting for more than 50% by weight of the hydrocarbon stream.

5. The process according to claim 1, wherein in Mode A, a mixture of the monoolefin-containing stream and steam is preheated to a temperature in a range from 480 to 560 °C, preferably in a range from 500 to 540 °C in the convection section before being mixed with the liquid feed stock.

6. The process according to claim 5, wherein the liquid feed stock is preheated to a temperature in a range from 230 to 300 °C, preferably from 250 to 280 °C in the convection section before being mixed with the mixture of the monoolefin-containing stream and steam.

7. The process according to claim 1 or 2, wherein in Mode A, the dosage ratio of the monoolefin-containing stream to steam ranges from 1:1 to 1:30 by weight, and/or the dosage ratio of the monoolefin-containing stream to the liquid feed stock ranges from 0.001:1 to 0.2:1 by weight.

8. The process according to claim 1 or 2, wherein in Modes B and C, the monoolefin-containing stream, hydrogen, steam and any mixtures thereof are all separately and optionally preheated to a temperature in a range from 120 to 660 °C, preferably 150 to 620 °C in the convection section.

9. The process according to claim 1 or 2, wherein in Modes B and C, the

Claims

1. A steam cracking process, comprising heating a liquid feed stock in a convection section of a cracking furnace and subsequently conveying the material to a radiant section of the cracking furnace for cracking reaction therein, wherein a monoolefin-containing stream is conveyed to the cracking furnace for cracking reaction through at least one of the following modes:

Mode A: mixing a first mixture with the liquid feed stock, heating the mixed resultant in the convection section, and then feeding it to the radiant section for cracking reaction;

Mode B: feeding the monoolefin-containing stream or the first mixture to an inlet of the radiant section, and mixing the same with material from the convection section; and

Mode C: feeding the monoolefin-containing stream or the first mixture to an outlet of the radiant section, and mixing the same with products of a first cracking reaction for a second cracking reaction;

wherein the monoolefin-containing stream is a hydrocarbon stream containing at least one selecting from a group consisting of ethylene, propylene, butene, pentene and hexene, the sum content of ethylene, propylene, butene, pentene and hexene accounting for more than 10% by weight of the hydrocarbon stream; and

wherein the first mixture is a mixture comprising the monoolefin-containing stream and at least one of steam and hydrogen.

2. The process according to claim 1, wherein in Mode A, the first mixture is mixed with the liquid feed stock outside the convection section before entering into a hybrid heating segment of the convection section.

3. The process according to claim 2, wherein the first mixture is first heated in a diluted steam superheating section of the convection section before being mixed with the liquid feed stock and then entering into the hybrid heating segment of the convection section.

4. The process according to any one of claims 1 to 3, wherein the monoolefin-containing stream is a hydrocarbon stream with the sum content of ethylene, propylene, butene, pentene and hexene accounting for more than 30% by weight of the hydrocarbon stream, preferably a hydrocarbon stream the sum content of butene, pentene and hexene accounting for more than 50% by weight of the hydrocarbon stream, and more preferably a hydrocarbon stream the sum content of 1-butene and 2-butene accounting for more than 50% by weight of the hydrocarbon stream.

5. The process according to claim 1, wherein in Mode A, a mixture of the monoolefin-containing stream and steam is preheated to a temperature in a range from 480 to 560 °C, preferably in a range from 500 to 540 °C in the convection section before being mixed with the liquid feed stock.

6. The process according to claim 5, wherein the liquid feed stock is preheated to a temperature in a range from 230 to 300 °C, preferably from 250 to 280 °C in the convection section before being mixed with the mixture of the monoolefin-containing stream and steam.

7. The process according to claim 1 or 2, wherein in Mode A, the dosage ratio of the monoolefin-containing stream to steam ranges from 1:1 to 1:30 by weight, and/or the dosage ratio of the monoolefin-containing stream to the liquid feed stock ranges from 0.001:1 to 0.2:1 by weight.

8. The process according to claim 1 or 2, wherein in Modes B and C, the monoolefin-containing stream, hydrogen, steam and any mixtures thereof are all separately and optionally preheated to a temperature in a range from 120 to 660 °C, preferably 150 to 620 °C in the convection section.

9. The process according to claim 1 or 2, wherein in Modes B and C, the