CLAIMS

[Claim 1] A thermal coupling method for preparing ethylene by ethanol dehydration, includes an ethanol dehydration reaction system, a quenching compression system, an alkaline washing system, a molecular sieve drying system and an ethylene purification and propylene refrigeration cycle system;

wherein ethanol dehydration reaction products in the ethanol dehydration reaction system serve as a heat source for preheating, vaporization and superheating of a raw material of ethanol; tower kettle fluid of an evaporation tower in the quenching compression system serve as a heat source for preheating of a feed stream of the evaporation tower and heating of an overhead gas of a quenching tower;

products of ethylene in the alkaline washing system serve as a cold source for cooling of crude ethylene; tower kettle fluid of the evaporation tower in the molecular sieve drying system serve as a heat source for preheating of circulating ethylene;

the products of ethylene in the ethylene purification and propylene refrigeration cycle system serve as a cold source for precooling of dried ethylene; the circulating ethylene serves as a cold source for cooling of an overhead gas of a demethanizing tower and cooling of propylene;

low-temperature propylene serves as a cold source for cooling of an overhead gas of a purification tower and further cooling of the ethylene; and

hot propylene serves as a heat source for heating of the tower bottoms of the demethanizing tower, the tower bottoms of the purification tower and the products of ethylene;

the quenching compression system includes an evaporation tower, an evaporation tower feed preheater, an evaporation tower reboiler, a quenching tower, a quenching tower overhead gas heater, a second gas-liquid separation tank, an evaporation tower bottom cooler and a process water tank; the tower bottoms of the evaporation tower enter the quenching tower overhead gas heater to heat the overhead gas of the quenching tower, and then the tower bottoms of the evaporation tower are fed into the process water tank, the evaporation tower reboiler condensates are fed into the molecular sieve drying system;

the alkaline washing system includes an alkaline washing tower, a crude ethylene cooler and a third gas-liquid separation tank; the products of ethylene from the

ethylene purification and propylene refrigeration cycle system enter the crude ethylene cooler to cool crude ethylene produced in the alkaline washing tower, and then the products of ethylene are fed into a product ethylene heater; and

the molecular sieve drying system includes drying towers, a circulating ethylene preheater and a steam condensate flash tank; the evaporation tower reboiler condensates from the quenching compression system enter the circulating ethylene preheater to preheat the circulating ethylene, and the cooled reboiler condensates are fed into the steam condensate flash tank.

[Claim 2] The thermal coupling method for preparing ethylene by ethanol dehydration according to claim 1, wherein the ethanol dehydration reaction system includes an ethanol preheater, ethanol evaporators, an ethanol evaporation tank, an ethanol superheater, a first gas-liquid separation tank, a third reactor and a heating furnace;

the ethanol dehydration reaction products enter the ethanol superheater to superheat ethanol steam;

the cooled reaction products enter the ethanol evaporators to vaporize the liquid phase raw material of ethylene, and then the reaction products enter the ethanol preheater to preheat the liquid phase raw material of ethylene;

the ethanol dehydration reaction products cooled repeatedly are fed into the first gas-liquid separation tank;

the tower bottoms of the evaporation tower enter the evaporation tower feed preheater to preheat the feed stream of the evaporation tower.

[Claim 3] The thermal coupling method for preparing ethylene by ethanol dehydration according to claim 1, wherein the ethylene purification and propylene refrigeration cycle system includes an ethylene precooler, an ethylene chiller, a demethanizing tower, a demethanizing tower condenser, a demethanizing tower reboiler, a purification tower, a purification tower condenser, a purification tower reboiler, an ethylene reflux tank, a propylene cooler, a fuel gas tank, a product ethylene heater, a primary propylene flash tank, a propylene collection tank, and a secondary propylene compressor;

the circulating ethylene enters the demethanizing tower condenser to cool the overhead gas of the demethanizing tower, the heated circulating ethylene is fed into the propylene cooler to cool propylene, and then the circulating ethylene is fed into the molecular sieve drying system;

the products of ethylene enter the ethylene precooler to cool the dried crude ethylene, and the heated products of ethylene are fed into the alkaline washing system, and then discharged out of a boundary region after being heated; the low-temperature propylene enters the purification tower condenser to cool the overhead gas of the purification tower, the heated low-temperature propylene is fed into the ethylene chiller to further cool the ethylene, and then the low-temperature propylene is fed into the primary propylene flash tank; and

hot propylene from the outside of the boundary region enters the demethanizing tower reboiler, the purification tower reboiler and the product ethylene heater respectively to heat the tower bottoms of the demethanizing tower, the tower bottoms of the purification tower and the products of ethylene, and the cooled propylene is fed into the propylene collection tank.

[Claim 4] A device for achieving the thermal coupling method for preparing ethylene by ethanol dehydration according to claim 1, wherein, in the ethanol dehydration reaction system, a tube pass inlet of the ethanol preheater is connected with a raw material tank area; a shell pass inlet of the ethanol preheater is connected with a shell pass outlet of the ethanol evaporator;

a tube pass outlet of the ethanol preheater is connected with an inlet of the ethanol evaporation tank;

a shell pass outlet of the ethanol preheater is connected with an inlet of the first gas-liquid separation tank;

a tube pass inlet of the ethanol evaporator is connected with an outlet in a bottom of the ethanol evaporation tank; a shell pass inlet of the ethanol evaporator is connected with a shell pass outlet of the ethanol superheater;

a tube pass outlet of the ethanol evaporator is connected with an inlet in a right side of the ethanol evaporation tank;

a tube pass inlet of the ethanol superheater is connected with an outlet ata top of the ethanol evaporation tank;

a shell pass inlet of the ethanol superheater is connected with an outlet of the third reactor;

a tube pass outlet of the ethanol superheater is connected with an inlet of the heating furnace;

in the quenching compression system, an outlet of the tower kettle of the evaporation tower is connected with a shell pass inlet of the evaporation tower feed preheater;

an outlet of the tower kettle of the quenching tower is connected with a tube pass inlet of the evaporation tower feed preheater;

a tube pass outlet of the evaporation tower feed preheater is connected with an inlet at a top of the evaporation tower;

a shell pass outlet of the evaporation tower feed preheater is connected with a shell pass inlet of the quenching tower overhead gas heater;

an overhead steam outlet of the quenching tower is connected with a tube pass inlet of the quenching tower overhead gas heater;

a tube pass outlet of the quenching tower overhead gas heater is connected with an inlet of the second gas-liquid separation tank; and

a shell pass outlet of the quenching tower overhead gas heater is connected with an inlet of the evaporation tower bottom cooler.

[Claim 5] A device for achieving the thermal coupling method for preparing ethylene by ethanol dehydration according to claim 1, wherein in the alkaline washing system, an overhead steam outlet of the alkaline washing tower is connected with a shell pass inlet of the crude ethylene cooler;

a tube pass outlet of the ethylene precooler is connected with a tube pass inlet of the crude ethylene cooler;

a shell pass outlet of the crude ethylene cooler is connected with an inlet of the third gas-liquid separation tank;

a tube pass outlet of the crude ethylene cooler is connected with a tube pass inlet of the product ethylene heater;

in the molecular sieve drying system, a shell pass inlet of the circulating ethylene preheater is connected with a shell pass outlet of the evaporation tower reboiler;

a tube pass inlet of the circulating ethylene preheater is connected with a tube pass outlet of the propylene cooler;

a tube pass outlet of the circulating ethylene preheater is connected with inlets of the drying towers; and

a shell pass outlet of the circulating ethylene preheater is connected with an inlet of the steam condensate flash tank.

[Claim 6] A device for achieving the thermal coupling method for preparing ethylene by ethanol dehydration according to claim 1, wherein in the ethylene purification and propylene refrigeration cycle system, a shell pass inlet of the ethylene precooler is connected with outlets of the drying towers;

a tube pass inlet of the ethylene precooler is connected with an outlet of the ethylene buffer tank;

a shell pass outlet of the ethylene precooler is connected with a shell pass inlet of the ethylene chiller;

a tube pass inlet of the ethylene chiller is connected with an outlet of the secondary propylene compressor;

a tube pass outlet of the ethylene chiller is connected with an inlet of a primary propylene separation tank;

a shell pass outlet of the ethylene chiller is connected with an inlet of the demethanizing tower;

an overhead steam outlet of the demethanizing tower is connected with a shell pass inlet of the demethanizing tower condenser;

a tube pass inlet of the demethanizing tower condenser is connected with an outlet of the ethylene reflux tank;

a tube pass outlet of the demethanizing tower condenser is connected with a tube pass inlet of the propylene cooler;

a shell pass outlet of the demethanizing tower condenser is connected with an inlet of the fuel gas tank;

an outlet of the tower kettle of the demethanizing tower is connected with a tube pass inlet of the demethanizing tower reboiler;

a tube pass outlet of the demethanizing tower reboiler is connected with an inlet of the tower kettle of the demethanizing tower;

a shell pass outlet of the demethanizing tower reboiler is connected with an inlet of the propylene collection tank;

an overhead steam outlet of the purification tower is connected with a shell pass inlet of the purification tower condenser;

a tube pass inlet of the purification tower condenser is connected with an outlet of the secondary propylene compressor;

a shell pass outlet of the purification tower condenser is connected with an inlet of the ethylene reflux tank;

a tube pass outlet of the purification tower condenser is connected with an inlet of the primary propylene flash tank;

an outlet of the tower kettle of the purification tower is connected with a tube pass inlet of the purification tower reboiler;

a tube pass outlet of the purification tower reboiler is connected with an inlet of the tower kettle of the purification tower;

a shell pass outlet of the purification tower reboiler is connected with an inlet in a top of the propylene collection tank;

a shell pass inlet of the propylene cooler is connected with an outlet at bottom of the propylene collection tank;

a shell pass outlet of the propylene cooler is connected with an inlet of the primary propylene flash tank; and

a shell pass outlet of the product ethylene heater is connected with an inlet at top of the ethylene collection tank.