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PROCESS FOR THE MANUFACTURE OF ETHYLENE FROM OIL

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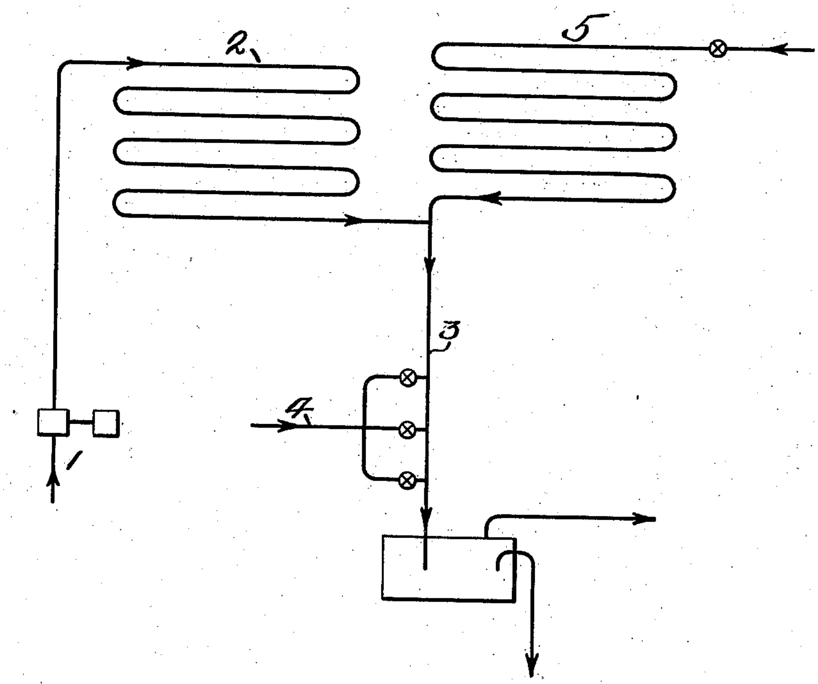

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PROCESS FOR THE MANUFACTURE OF ETHYLENE FROM OIL

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2 Claims. (Cl. 260—170)

The subject matter of this invention is a new method for producing ethylene, a hydrocarbon gas C_2H_4 of the olefin series, from liquid hydrocarbon mixtures of the type found in petroleum, in which new process the correlation of temperatures, reaction velocities and reaction periods of time produce yields of ethylene far in excess of the yields by the current methods of producing ethylene from hydrocarbons.

In the oil industry ethylene is a by-product in converting heavy-oil to gasoline by pyrolysis and the yield of ethylene, depending upon whether the liquid or the vapor phase method of cracking is employed, varies in amounts up to approximately 6% by weight of the charging stock.

In the chemical industry, in the operation directed to the production of ethylene from liquid hydrocarbons, a variation of the vapor phase method used in the oil industry is employed.

In the oil industry the yield of liquids is in the order of 75% by weight of the charging stock and the ethylene yield as above indicated is only about 6%; in the chemical industry the yield of liquids is in the order of 40% by weight of the charging stock and the ethylene yield is in the order of 10% by weight of the charging stock.

As distinguished from these prior processes, the present invention provides a method wherein substantially all of the oil charging stock is converted to fixed gas of less than four carbon atoms, the major constituent of which is ethylene, the yield of ethylene being substantially 45% by weight of the hydrocarbon content of the charging stock with practically no yield of condensate.

One of the objects of this invention is the production of ethylene as the primary product of the operation in converting substantially all of the charging stock to gases, the yield of condensible polymers being inhibited substantially to exclusion. This operation is not of necessity an adjunct to oil refinery operations but can be conveniently located wherever ethylene is desired for use either directly or as a process material.

Another object of this invention is the production of ethylene from liquid hydrocarbons, wherein I obtain a yield of ethylene as high as 45% by weight of the hydrocarbons charged, my method providing for the flash system cracking of preheated liquid hydrocarbons, the ethylene thus produced being prevented from polymerizing to heavier hydrocarbons, thereby insuring the maximum yield of ethylene and the minimum yield of liquids.

My new process produces these novel results from liquid hydrocarbons in a continuous operation, the process comprising the operations of preheating the oil to a sufficiently high temperature while subjected to suitable pressure and velocity so that upon flashing the preheated oil into a hotter reaction zone substantially all of the oil is almost instantly heated and cracked to ethylene and hydrocarbons of less than four carbon atoms, this hot gas being immediately shock chilled below the polymerization temperature zone to practically exclude polymerization before a substantial amount of ethylene is polymerized.

In the accompanying drawing I have illustrated diagrammatically an embodiment of my invention.

As an example of the practice of my invention for the production of ethylene from heavy oil charging stock: The oil to be processed is taken from any suitable source of supply 1 and supplied to the pressure preheater 2 at a pressure in the order of, for example, 20 atmospheres or higher pressure, flowing continuously through the preheater to the reaction zone 3. The oil is preheated to a temperature in the order of 850° F. In the preheating step of my process temperature and pressure conditions are so controlled that the oil remains in the liquid phase. The preheated oil is continuously injected into the hotter reaction zone 3, flashing into vapor, the temperature of the hotter reaction zone being so controlled that substantially all of the oil vapor is converted to ethylene and hydrocarbons of less than four carbon atoms at a temperature of in the order of 1400° F.

Before a substantial amount of ethylene is polymerized, the hot gases are shock chilled to below 1000° F. preferably by means of water or steam injected as a continuous flow into the gas as indicated at 4 on the drawing, so as to practically exclude polymerization, thereby avoiding yield of a substantial quantity of condensate, oil, tar, etc., i. e., not in excess of 10% condensate by weight of the charging stock. Thereby practically all the charging stock is converted by pyrolysis to gas and maintained as a fixed gas. The cooled gas flows to a fractional distillation unit which separates the ethylene from the products of pyrolysis, or the ethylene by chemical reaction is separated as ethylene derivatives from the fixed gas.

The liquid hydrocarbons used as the charging stock are preferably gas oil and oils heavier than gas oil.

The hot oil to be converted to ethylene and other gases of less than four carbon atoms is flashed into a hotter reaction zone, the source of the heat of this hotter reaction zone being a superheated condensible vapor or gas 5 as a heat carrying medium acting as a sweep gas flowing through the hot reaction zone or cracking race 3 into which the hot oil is flashed. Through convection by diffusion with the superheated condensible vapor or gas as for example superheated steam, practically all of the hot oil instantly attains a temperature that practically instantly gasifies substantially all of the hydrocarbons to less than four carbon atoms, and before a substantial amount of polymerization takes place the gases are shock chilled with a cool condensible vapor, water or steam 4, to practically exclude the formation of condensate oils, tar, etc. and retain practically all of the oil in the form of fixed gas.

In the example given above I have mentioned temperature in the order of 1400° F. with reference to the gas in the reaction zone. It is to be understood that with different charging stocks the temperature at which the reaction takes place and the time necessary to obtain the optimum yield of ethylene therefrom vary, but in any case the temperature should not be less than approximately 1200° F. and the reaction time should not exceed approximately one and one-half seconds to avoid producing condensates. Furthermore, the temperature should not exceed 1600° F. because at such temperature ethylene decreases. Preferably the temperature ranges between 1300° F. and 1500° F. and the time varies in inverse relation to the temperature, preferably ranging from approximately one and one-half seconds to less than one-half second in order to obtain the optimum yield of ethylene.

Several connections for shock chilling may be made at different points along the length of the hot reaction zone cracking race 3 for the purpose of regulating the oil vapor heat treatment time before shock chilling takes place.

When the condensible vapor used as the sweep gas in the reaction zone is superheated steam, before any substantial amount of said reactions between the steam and hydrocarbons takes place, the gases are shock chilled as hereinabove described, this shock chilling also practically inhibiting to exclusion such side reactions.

It will be seen from all of the foregoing that the present invention provides a process for converting oil to a fixed gas of less than four carbon atoms, the major constituent of which is ethylene, the process being such that substantially all of the oil is converted to the desired fixed gas.

What I claim is:—

1. The process of producing ethylene from oil, which process comprises preheating the oil under superatmospheric pressure while maintaining the oil slightly below its vaporizing temperature at that pressure, injecting all of the preheated liquid oil into a flowing superheated condensible vapor which contains sufficient heat for heat exchange to the preheated oil to flash heat the preheated oil to within the temperature range of 1300° F. to 1600° F., at which temperature all of the hydrocarbons of the oil are instantly decomposed to ethylene and hydrocarbons of not more than four carbon atoms, and immediately upon attaining this temperature shock cooling the gaseous mixture to below 1000° F. to exclude polymerizing reactions forming gasoline hydrocarbons and to retain the hydrocarbons as ethylene and hydrocarbons of not more than four carbon atoms.

2. The process of producing ethylene from heavy oil, which process comprises preheating the oil to a temperature in the order of 850° F. while subjected to superatmospheric pressure, controlling pressure and time conditions while preheating so that the oil remains in the liquid phase, injecting all of the preheated oil into a flowing superheated condensible vapor which contains sufficient heat for heat exchange to the preheated oil to flash heat the preheated oil to within the temperature range of 1300° F. to 1600° F., at which temperature all of the hydrocarbons of the oil are instantly decomposed to ethylene and hydrocarbons of not more than four carbon atoms, and immediately upon attaining this temperature shock cooling to below 1000° F. to exclude polymerizing reactions forming gasoline hydrocarbons and to retain the hydrocarbons as ethylene and hydrocarbons of not more than four carbon atoms.

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