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CONVERSION OF HYDROCARBONS

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STABILIZER

COOLER

HOT QUENCH HEATER

CHARGING STOCK

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This invention relates to the conversion of hydrocarbons and has particular reference to certain improvements associated with the cooling or quenching of the products of conversion.

In the cracking or conversion of light hydrocarbons, such as in the pyrolysis or polymerization of normally gaseous hydrocarbons and in the cracking of light oil stocks as in the reforming of naphtha or gasoline stocks, the products of conversion leaving the reaction zone consist of a small amount of heavy tarry matter, varying amounts of gasoline and normally gaseous hydrocarbons and relatively small proportions of constituents of boiling range intermediate the gasoline and the tar. Because of its composition the mixture of products leaving the reaction zone is no doubt ordinarily in a single phase, i.e., in a gaseous or vapor phase at the temperatures and pressures usually existing in the transfer line from the reaction zone. Any material reduction in the temperature of the mixture of products leaving the reaction zone will result in phase separation and the material first separated out as a result of the cooling is a very heavy tar of high viscosity and of relatively poor thermal stability. The heavy material thus separated tends to be deposited on the walls of the transfer line and to decompose causing carbon or coke deposition which sooner or later necessitates an interruption of the operation.

A common method of procedure is to introduce a cooling or quenching liquid into the transfer line mixture, at temperatures very materially lower than that of the mixture with the object in view of retarding or preventing further cracking and avoiding any undue coke formation in the transfer line and heat exchangers, as well as in the subsequent fractionation of the products of conversion. I have found that when using a quenching medium in this manner there is a tendency toward the cooling of the transfer line and in certain cases that the thermal conduction of the metal tends to cool a material portion of the transfer line stream at some distance upstream from the quench point and as a result phase separation occurs which results in the deposition of heavy tarry material in the transfer line, eventually resulting in coke formation so that transfer line stoppage occurs upstream from the quench point.

In accordance with my invention these difficulties are overcome by introducing a liquid solvent or oil into the transfer line at a temperature approximating that of the products of conversion therein. The introduction of the oil tends to raise the dew point of the transfer line mixture and so functions that when, and as, any phase separation occurs the first condensate has a much lower viscosity (better fluidity) and a much better thermal stability than the heavy tar which separates normally without the introduction of the hot quench, with the result that the condensed liquid may be carried along in the transfer line stream without deposition on the walls of the transfer line and without decomposition into coke.

In practicing the invention hydrocarbon oil higher boiling than gasoline is heated to a temperature approximating that of the stream of cracked products which it is desired to cool or quench and the preheated oil is introduced into the transfer line. The resulting mixture is then subjected to cooling by reduction in pressure or by being contacted with a cooling medium or by both the introduction of a cooling medium and reduction in pressure. It is desirable to employ as the heated medium which is introduced into the stream of products of conversion a relatively refractory stock such as a stock derived from a previous cracking or conversion operation so that there will be a minimum extent of cracking of the introduced stock. It is also desirable to employ a stock of intermediate boiling range such as gas oil. Ordinarily the quantity of hot quench oil required will be of the order of 10%-30% of the products (liquid volume) leaving the reaction zone.

For the purpose of more fully disclosing the invention reference is now had to the accompanying drawing which is a flow diagram illustrating a particular example of the invention in which it is applied in a gas reversion process.

In the drawing the heating coil 10 is adapted to be heated to a desired cracking or conversion temperature by means of the furnace 11 and oil stock for conversion is introduced by pump 12 to the heating coil 10. The products of conversion pass through a transfer line 13 to a separating and fractionating tower 14. A pressure reduction valve 15 is ordinarily disposed in the transfer line. In the tower 14 the products of conversion are separated into vapors and residue and the vapors are subjected to fractionation to form reflux condensate which may be collected in a tray 16. Uncondensed vapors and gases pass overhead from the tower to a condenser 17 and the gasoline or motor fuel distillate of desired boiling range is collected in a receiving drum or gas separator 18 having a gas outlet 19. The distillate is directed by a pump 20 to a rectifying
In the conversion of relatively light hydrocarbons of the nature of normally gaseous hydrocarbons and gasoline hydrocarbons wherein the hydrocarbons are heated to a cracking temperature in a heating zone and subjected to conversion to produce a resultant vaporous mixture of reaction products composed of a relatively small proportion of potential tarry or residual constituents, a relatively large proportion of gasoline hydrocarbons and normally gaseous hydrocarbons and a relatively small proportion of intermediate constituents and wherein the vaporous mixture is passed in a continuous stream from the heating zone to a separating zone, the process comprises introducing into said continuous stream flowing from the heating zone to the separating zone, prior to any substantial cooling thereof, a heated oil consisting essentially of constituents boiling within a range of 600° F. to 750° F. and in sufficient quantity to raise the dew point of the mixture without substantially lowering the temperature thereof so that upon subsequent cooling and phase separation said heated oil will function to dilute the first tarry constituents condensed out and lower the viscosity thereof into the stream a relatively cool oil to lower the temperature thereof and separating the cooled products into vapors and residue.

2. In the conversion of relatively light hydrocarbons of the nature of normally gaseous hydrocarbons and gasoline hydrocarbons wherein the hydrocarbons are heated to a cracking temperature in a heating zone and subjected to conversion to produce a resultant vaporous mixture of reaction products composed of a relatively small proportion of potential tarry or residual constituents, a relatively large proportion of gasoline hydrocarbons and normally gaseous hydrocarbons and a relatively small proportion of intermediate constituents and wherein the vaporous mixture is passed in a continuous stream from the heating zone to a separating zone, the process comprises introducing into said continuous stream flowing from the heating zone to the separating zone, prior to any substantial cooling thereof, a heated oil stock comprising essentially constituents boiling within a range of 600° F. to 750° F. in a quantity of the order of 10% to 30% of the liquid volume of the products flowing in said stream to thereby raise the dew point of the mixture without substantially lowering the temperature thereof so that upon subsequent cooling and phase separation said heated oil stock so introduced will function to dilute the first tarry constituents condensed out and lower the viscosity thereof and thereafter subjecting the mixture having the increased dew point to cooling to produce phase separation.

3. In the conversion of relatively light hydrocarbons of the nature of normally gaseous hydro-
carbons and gasoline hydrocarbons wherein the hydrocarbons are heated under superatmospheric pressure to a cracking temperature in a heating zone and subjected to conversion to produce a resultant vaporous mixture of reaction products composed of a relatively small proportion of potential tarry or residual constituents, a relatively large proportion of gasoline hydrocarbons and normally gaseous hydrocarbons and a relatively small proportion of intermediate boiling constituents and wherein said vaporous mixture is passed in a continuous stream from the heating zone to a lower pressure separating zone, the process that comprises rapidly passing a thermally refractory gas oil stock in a quantity of the order of 10% to 30% of the liquid volume of said stream through a heating zone wherein it is brought to a temperature approximating that of said continuous stream under conditions to prevent substantial cracking, introducing the resultant heated higher boiling stock into said continuous stream flowing from the heating zone to the separating zone, prior to any substantial cooling thereof, to thereby raise the dew point of said continuous stream without substantially lowering the temperature thereof so that upon subsequent cooling and phase separation the oil so introduced will function to dilute the first tarry constituents condensed out and lower the viscosity thereof, thereafter introducing into the stream a relatively cool oil to lower the temperature thereof and reducing the pressure thereon for delivery to the lower pressure separating zone.

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