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TREATING HYDROCARBON FLUIDS

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This invention relates to the catalytic conversion of hydrocarbons containing aromatic constituents and more particularly relates to the catalytic conversion of aromatic extracts.

In the catalytic cracking of higher boiling hydrocarbons such as gas oils and the like, it has been found that the condensate oil separated from the reaction products is refractory and is not a very good stock for recycling to the catalytic conversion zone. It is known that such condensate oils contain a relatively large amount of aromatic constituents. Although low conversions characterize the majority of aromatic stocks under the conditions usually used in catalytic cracking, I have found that I obtain relatively high yields of low boiling hydrocarbons especially suitable for use as solvents when catalytically cracking certain aromatic stocks such as aromatic extracts or extracts of hydrocarbon oils containing aromatic constituents.

According to my invention, relatively light aromatic hydrocarbon extracts such as sulphur dioxide extracts of kerosene containing aromatic constituents and extracts of similar hydrocarbons, are subjected to catalytic cracking in the presence of a suitable cracking catalyst to produce about 10 to 20% of low boiling compounds boiling below about 200 or 250° F. My invention is concerned with the catalytic cracking of relatively light aromatic hydrocarbon extracts as distinguished from relatively heavy aromatic extracts of relatively heavy oils. Aromatic extracts of relatively light distillates such as gasoline or kerosene are preferred feed stocks for my invention. A solvent extract of a gasoline produced from a crude containing a relatively large amount of aromatic constituents forms a good feed stock for my invention. Other similar aromatic fractions having the characteristics of the relatively light aromatic extracts above described may be used.

My invention will now be described in greater detail. A fraction or hydrocarbon mixture containing aromatic constituents obtained by suitable solvent extraction of distillates such as a gasoline produced from a crude oil containing a relatively large amount of aromatic constituents, kerosene or heavy kerosene is heated to an elevated temperature of about 800–1000° F., in order to substantially completely vaporize the solvent extract. The solvent extract is obtained in any well-known solvent extraction process, as for example by treating kerosene or the like with liquefied sulphur dioxide to separate aromatic constituents from the kerosene. The

solution of aromatic constituents in the sulphur dioxide is separated from the remaining oil, the solvent or sulphur dioxide is removed and the remaining extract forms the feed stock for my invention. Any suitable solvent may be used in the solvent extraction.

The aromatic extract heated to an elevated temperature in any suitable manner is passed through a chamber containing a suitable catalyst for catalytically cracking the aromatic extract to produce lower boiling hydrocarbons. After the desired extent of cracking or conversion is obtained, the reaction products are passed to a fractionating tower to separate relatively light hydrocarbons from a condensate oil withdrawn from the bottom of the fractionating tower. If desired, side streams of hydrocarbon fractions may be removed from the side of the fractionating tower. The fractionation step is preferably so carried out that a light fraction boiling up to about 212° F., is obtained and this fraction is particularly suitable as a solvent. Or the fractionation may be so carried out that a motor fuel containing gasoline constituents is obtained.

The condensate oil may be passed to storage or may be further treated in any desirable manner and then recycled to the catalytic cracking zone or chamber. If desired, the condensate oil without further treatment may be recycled to the catalytic cracking zone.

As catalysts in my process, I may use natural clays, activated clays, such as hydrated silicates of alumina, synthetic clays such as synthetic gels containing alumina and silica and catalysts supported on alumina or the like. Instead of having a stationary bed of catalyst through which the vapors of the aromatic extract are passed, I may inject powdered catalyst into the aromatic extract vapors or the powdered catalyst may be mixed with the liquid aromatic extract before it is heated to an elevated temperature.

In the catalytic cracking of hydrocarbons, the catalyst becomes coated with carbonaceous material and its activity is reduced and it is desirable to regenerate the catalyst for further use. One method of regenerating the catalyst is to pass air or oxygen-containing gas over the catalyst particles to burn off the carbonaceous deposit. It is necessary to carefully control the temperature during regeneration to prevent the catalyst particles from being raised to too high a temperature, as high temperatures are harmful to the catalyst.

Specific examples of my invention are included

in the data given in the following table in which an activated clay was used as the catalyst:

desirable to solvent extract cycle oils from catalytic cracking or thermal cracking operations

Feed stock	SO ₂ extract from kerosene obtained from East Texas crude oil	SO ₂ extract from distillate containing aromatic constituents	Aromatic extract from distillate obtained from crude oil containing aromatic constituents
Feed stock inspections:			
Gravity..... °A. P. I.	26.8	19.8	17.6
Aniline point..... °F	43	-9.0	-4.0
Initial boiling point..... °F	300		422
50% point..... °F	438	485	404
Final boiling point..... °F	568		561
Color R.....	10.0	2.65	11.5
Carbon residue.....	0.02	0.10	0.01
Length of cracking cycle..... hours	4	4	4
Av. catalyst temp..... °F	861	854	854
Feed rate—vol. oil/vol. cat./hr.	0.6	0.6	0.6
Conversion on feed:			
Gas..... weight percent.	2.3	3.3	3.0
Gasoline..... volume percent (stabilized)	48.4	26.9	21.6
Excess butane..... volume percent.	0	0	0
Cycle oil..... do.	43.6	73.9	76.9
Coke and handling loss..... weight percent.	7.4	5.4	9.0
Gasoline inspections:			
Gravity..... °A. P. I.	40.3	43.4	41.5
R. V. P.....	5.5	10	7.7
Octane No. C. F. R. MM.....	70.5	84	86.5
Aniline point..... °F	14	-5	<-5
D & L %:			
158.....	5	10.5	15
212.....	11	21	26
267.....	17.5	32.5	38
Final boiling point.....	408	415	412
Cycle oil inspections:			
Gravity..... °A. P. I.	19.2	17.7	15.8
Aniline point..... °F	14	30	35
50%.....	470	489	470
Gas inspections:			
Av. mol. wt.....	19.6	23.6	16.9
H ₂ volume percent.	33.7	23.7	35.3
Unsaturates..... do.	16.2	15.4	15.1

From the above data, it will be seen that the catalytic cracking of aromatic extracts results in relatively high yields of lower boiling hydrocarbons suitable for use as solvents. My invention can also be carried out to produce aromatic gasolines. I am not to be restricted to the above examples as different yields may be obtained by use of different cracking conditions.

The solvent extracts to be catalytically cracked according to my process are preferably so chosen that they contain relatively large amounts of single ring aromatic compounds rather than double ring aromatic compounds. When a virgin gas oil is treated successively with a selective solvent or with a series of selective solvents in order of increasing solvent power, the double ring aromatic compounds are the first to be removed, the single ring aromatic compounds next, and naphthenes and paraffins last. By well known methods of solvent extraction, it is possible then to separate a virgin gas oil into three cuts, namely one containing primarily double ring aromatic compounds, one containing primarily single ring aromatic compounds, and a residual raffinate containing naphthenes and paraffins. For my process, which is designed primarily for the production of low boiling aromatics in the gasoline and heavy naphtha range, the intermediate cut, namely that containing primarily single ring aromatic compounds is the most desirable. However, certain virgin feed stocks in the kerosene and gasoline range contain very little double ring aromatic compounds, while they contain appreciable amounts of single ring aromatic compounds. In such cases it is not necessary to go to the expense of removing the small amounts of double ring aromatic compounds, and therefore a primary or single extract from the gas oil can be used as feed to this catalytic cracking process. In some cases it is economically

for removal of double ring aromatic compounds. In these cases it might be economical to further extract such cycle stocks to produce a cut containing primarily single ring aromatic compounds. It is intended that single ring aromatic concentrates obtained from cycle oils be included within the scope of my invention. For the purpose of clarity, double ring aromatic concentrates may be defined as those having specific dispersions above about 175, single ring aromatic concentrates can be defined as those having specific dispersions between about 110 and 175, and raffinates substantially free of all types of aromatics may be defined as those having specific dispersions below about 110.

While I have given specific examples of my invention, it is to be understood that they are merely by way of illustration and that I am not to be limited thereto, and that modifications and changes may be made within the scope of the invention without departing from the spirit of my invention.

I claim:

1. A method of producing a low boiling hydrocarbon material suitable for use as a solvent from a hydrocarbon oil stock containing straight chain aliphatic hydrocarbons, single ring aromatic hydrocarbons and double ring hydrocarbons which comprises extracting said hydrocarbon oil stock with a suitable selective solvent to remove substantially all of the double ring aromatic hydrocarbons, further extracting the remaining oil stock with a second solvent suitable for extracting from said stock a fraction containing a relatively large amount of single ring aromatic compounds, heating said fraction containing large amounts of single ring aromatic compounds to an elevated temperature and passing it through a catalyst chamber wherein it is maintained under cracking conditions in the presence of catalyst particles for a sufficient time

to produce a substantial amount of lower boiling constituents and separating a relatively low boiling fraction of high aromatic content from the cracked products.

2. A method according to claim 1 in which the original hydrocarbon oil stock is a virgin gas oil.

3. A method according to claim 1 wherein the

fraction containing large amounts of single ring aromatic compounds has a boiling range between about 300° and about 600° F.

4. A method according to claim 1 in which the fraction containing large amounts of single ring aromatic compounds has a relatively low aniline point, below about 50.

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