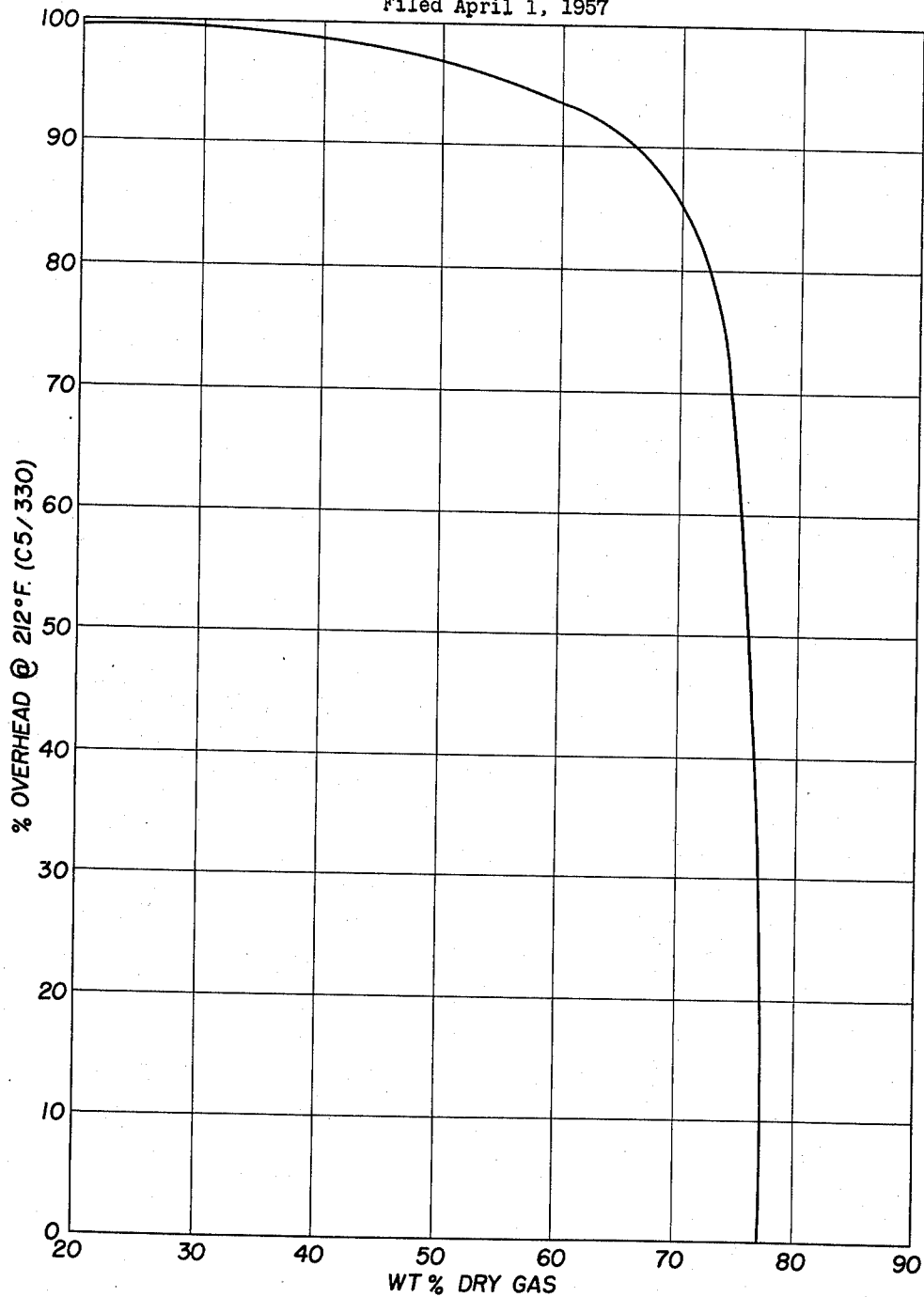


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UPGRADING LIGHT VIRGIN NAPHTHA

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UPGRADING LIGHT VIRGIN NAPHTHA

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4 Claims. (Cl. 208—130)

This invention relates to an improved process for upgrading a light virgin naphtha. More particularly it relates to a process of this nature in which these naphthas are thermally cracked in the presence of steam under controlled conditions so as to yield a gasoline of superior octane and volatility characteristics.

In some regions recently the demand for middle distillates, i.e., diesel and jet aircraft fuels as well as domestic and industrial fuels, has become quite high in relation to gasoline. As a result, situations have developed where the supply of light naphtha exceeds that needed for gasoline while all the middle distillates produced find an attractive market as fuels. There is thus little economic incentive to catalytically crack the middle distillates to high octane lower boiling fractions. The light virgin naphthas available, however, can be undesirably low in octane number, particularly in the so-called road octane or actual car performance characteristics. When the virgin naphthas are employed in many automobiles there is a fractionation effect with the light ends predominating in the engine cylinders. This results in low road octanes, pinging and knocking. These light ends of the virgin naphtha unlike the heavy ends are not subject to much improvement by hydroforming. While the road octane characteristics can be improved by steam cracking, volatility reduction can occur to such an extent that the product can be shifted substantially out of the gasoline range.

This invention provides a method for upgrading the light virgin naphtha. The method comprises thermally cracking the naphtha in the presence of steam to a carefully controlled dry gas conversion level of 60 to 70 wt. percent based on the feed. This yields a naphtha product which has both superior octane and volatility characteristics. Further details are presented below.

It is indeed surprising that it is necessary to closely control a process as regards dry gas conversion in order to obtain the product of desired characteristics. Experiments have demonstrated, however, that insufficient conversion to dry gas gives a product whose octane number is less than that desired. Conversely, exceeding the desired conversion level sharply and undesirably reduces the volatility. This is demonstrated in the graph shown in the drawing. This drawing demonstrates the very sharp drop in volatility that occurs in the region of the 60 to 70 wt. percent dry gas conversion points. Conversely, the octane number improvement below a 60 wt. percent conversion to dry gas is insufficient to meet modern automobile requirements. The research octane number when used herein refers to what is known as "Research Octane" rating or A.S.T.M. Test D-908-47T.

The light virgin naphthas treated by the process of this invention have a boiling point in the range of 0° to 200° F. and preferably in the range of 65° to 160° F. Typical of these are Middle Eastern virgin naphthas such as the Arabian naphtha on which an analysis is presented below.

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TABLE I

Analysis of cracking feed

5	Boiling range, ° F. -----	65/160
	Gravity, ° API -----	84.6
	Research octane number -----	65.1
	Percent overhead @ 212° F. -----	100.0

Composition weight percent

10	Isobutane -----	0.1
	Normal butane -----	0.5
	Isopentane -----	11.0
15	Normal pentane -----	26.0
	2,2 dimethylbutane -----	0.2
	2 methylpentane; cyclopentane; 2,3 dimethyl butane -----	17.4
	3 methylpentane -----	10.1
20	n-Hexane -----	25.5
	2,4 dimethylpentane; methylcyclopentane -----	5.7
	Benzene -----	1.6
	2,3 dimethylpentane; cyclohexane -----	1.5
	3 methylhexane; 2 methylhexane -----	0.2
25	3 ethylpentane -----	0.1
	n-Heptane -----	0.1

The light virgin naphthas are thermally cracked as stated previously to a dry gas conversion of 60 to 70 wt. percent based on the feed. Dry gas refers to hydrogen and low boiling hydrocarbon gases containing 1 to 3 carbon atoms, e.g., methane, ethane, propane, ethylene and propylene.

The light virgin naphtha is steam cracked in the conventional manner except for the control of the conditions and can be treated in one or more cracking coils. It is thus thermally cracked at a temperature in the range of 1400° to 1500° F. and at a low pressure, i.e. 25 to 55 p.s.i.a., preferably 30 to 40 p.s.i.a. The light virgin naphtha is admixed with steam to give a mixture containing about 15 to 25 mol percent naphtha feed and 75 to 85 mol percent steam. The hydrocarbon partial pressure is thus in the range of about 5 to 20 p.s.i.a., preferably 10 to 18 p.s.i.a. The mixture is allowed to remain under reaction conditions for a residence time so as to obtain a dry gas conversion of 60 to 70 wt. percent on feed, typically about 0.1 to 1.0 second.

This invention will be better understood by reference to the following examples.

EXAMPLES

Samples of Arabian naphtha having the properties and composition as designated in Table I were steam cracked at two sets of conditions (column I and II) which were within the range described in this invention, and an excessive conversion (column III). The operating conditions, product distribution, and 65/330° FVT product quality pertaining to these runs are listed in Table II. All product yields and qualities were determined following clay treating of the raw steam cracked product. It is readily apparent from these data that the octane number of the 65/330° FVT steam cracked naphtha increases to a very high level. The data also show that the volatility (measured as the volume percent taken overhead at 212° F. during a naphtha distillation—ASTM D-86) decreases quite markedly to an undesirably low level at high dry gas conversion levels above that of this invention (column III). It is also well to note that the yield of 330+° FVT bottoms out of the gasoline range is higher at 77.3 wt. percent conversion of the feed to dry gas than at the 68.5 wt. percent dry gas level.

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TABLE II

Operating conditions and yields of products from steam cracking

	I	II	III
Conversion.....	63.8	68.5	77.3
Operating conditions:			
Lead bath temperatures, ° F.—			
Oil preheat coil.....	1,350	1,350	1,350
Steam preheat coil.....	1,450	1,450	1,400
Soaking coil.....	1,450	1,450	1,400
Coil pressure, p.s.i.a.....	37	52	38
Hydrocarbon partial pressure, p.s.i.a.....	12.1	14.0	15.3
Contact time, sec.....	0.39	0.34	0.70
Steam diluent, mol. percent.....	80.1	80.7	80.7
Dry gas yields, weight percent FF:			
Hydrogen.....	0.7	0.7	0.9
Methane.....	11.3	13.5	16.9
Ethane.....	5.2	6.7	6.4
Ethylene.....	25.1	25.1	30.6
Propane.....	0.5	0.8	0.8
Propylene.....	21.0	21.7	21.7
C ₄ Yields, weight percent FF:			
n-Butane.....	0.8	1.5	0.3
i-Butane.....	0.2	0.3	0.3
Mixed butenes.....	8.2	8.2	7.2
Total.....	9.2	10.0	7.8
65/330° FVT liquid product:			
Yield, weight percent FF.....	21.2	17.9	10.7
Gravity, ° API.....	67.3	63.4	51.2
Research octane, clear.....	78.1	86.3	100.0
Percent overhead at 212° F.....	88.5	91.5	10.0
330+° FVT liquid product: Yield, weight percent FF.....	5.8	3.6	4.2

Samples of virgin Arabian naphtha were steam cracked in accordance with the teaching of this invention. Great front end improvement was obtained resulting in good road octane in the following types of automobiles, Alpha Romeo, Lancia, Vauxhall and Borgeward. Similar results are obtained on American cars.

The steam cracked naphtha can be processed in various

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conventional manners such as clay or aluminum chloride treating.

The dry gas can also be recovered in the conventional manner and has utility in the manufacture of various chemicals. The materials can be additionally worked up if desired.

The advantages of this invention will be apparent to those skilled in the art. Light naphthas of superior front end and road octane and volatility characteristics are obtained in an economic manner without the necessity of decreasing middle distillate inventories.

It is to be understood that this invention is not limited to the specific examples which have been offered merely as illustrations and that modifications can be made without departing from the spirit of the invention.

What is claimed is:

1. A method of upgrading a light virgin naphtha feed having a boiling point in the range of 0° to 200° F. which comprises thermally cracking from 15 to 25 mol percent of the naphtha feed with from 75 to 85 mol percent steam at a temperature in the range of 1400° to 1500° F. and a pressure of 25 to 45 p.s.i.a. for a residence time below about 1 second to obtain a dry gas conversion of 60 to 70 wt. percent on feed whereby a naphtha product of superior octane and volatility characteristics is obtained.

2. The process of claim 1 in which the feed boiling point is in the range of 60° to 160° F.

3. The process of claim 2 in which the pressure is 30 to 40 p.s.i.a.

4. The process of claim 3 in which the hydrocarbon partial pressure is 10 to 18 p.s.i.a.

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