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SOLVENT EXTRACTING CATALYTIC CRACKING FEED

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2 Sheets-Sheet 1

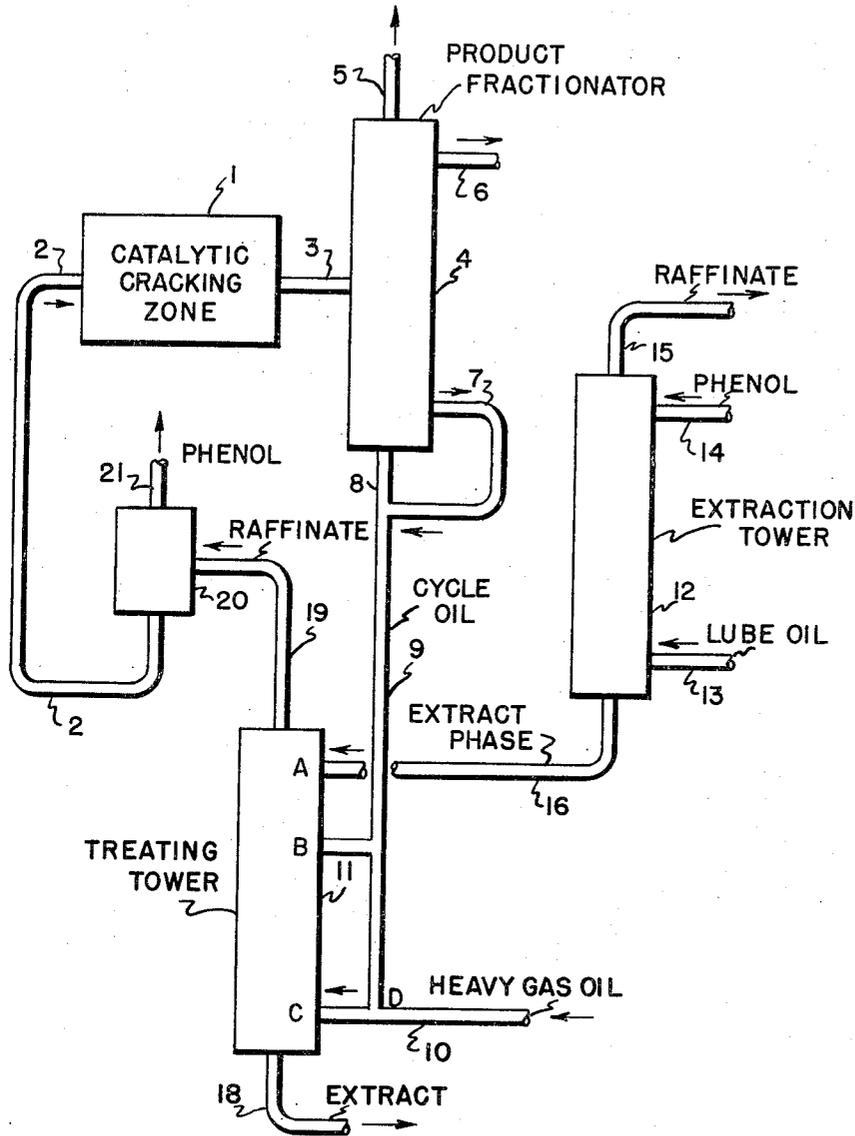


Fig. 1

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Fig.2

EXTRACTION OF GAS OIL

B= FRESH PHENOL

A= LUBE OIL EXTRACT PHASE

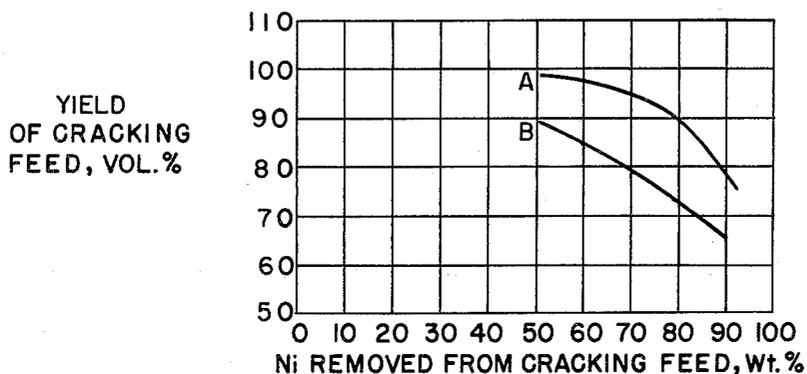
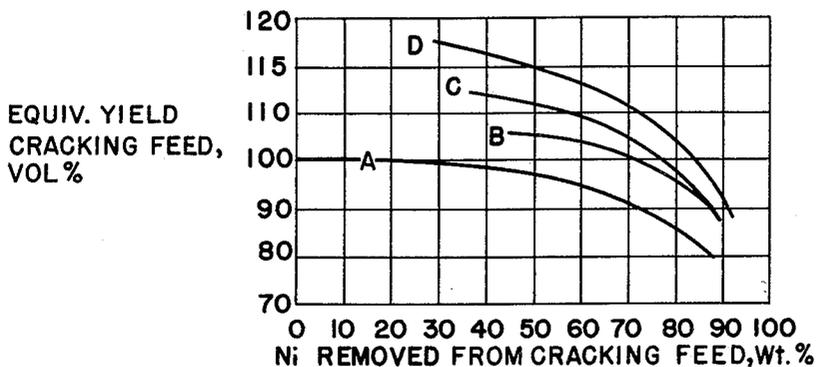


Fig.3

EXTRACTION OF CLARIFIED OIL-GAS OIL MIXTURES WITH LUBE-OIL EXTRACT

- A= 0% CL. OIL - 100% G.O.
- B= 33% CL. OIL - 67% G.O.
- C= 50% CL. OIL - 50% G.O.
- D= 67% CL. OIL - 33% G.O.



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SOLVENT EXTRACTING CATALYTIC  
CRACKING FEED

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5 Claims. (Cl. 208—251)

This invention relates to the refining of petroleum oils by means of a catalytic cracking operation. The invention particularly provides a novel process for the upgrading of potential catalytic cracking feed stocks so as to improve the characteristics of these stocks for catalytic cracking. The invention includes a method for improving the value of the heavy gas oil fractions of a petroleum oil for catalytic cracking by the substantial elimination of organic compounds containing metal contaminants that normally are present in the gas oil.

Furthermore, the invention in one of its applications includes provision for improving the cracking quality of lube oil extracts that have been extracted from lube oil distillates by solvent extraction. The invention includes provision for improving the cracking characteristics of catalytic cycle oil by elimination of high molecular weight aromatic hydrocarbon types which are refractory to cracking. In one application of this invention this removal or reduction is accomplished by utilizing the spent solvent from lube oil extraction prior to the normal recovery of this solvent for re-use.

The basic feature of this invention concerns the solvent extraction of a mixture of heavy gas oil and catalytic cycle oil. The solvent employed is any one of the conventional solvents having preferential solvent properties for removal of aromatic hydrocarbons. Such solvents include phenol, furfural, nitrobenzene, etc. Solvent extraction of a mixture of gas oil and cycle stock results in a synergistic removal of constituents of both the cycle stock and gas oil which are undesirable for catalytic cracking in a manner providing improved yields of high quality cracking feed stock.

Use of the spent solvent or extract phase of a lubricating oil extraction process for the extraction of the mixture of cycle stock and gas oil is particularly desirable.

In this aspect, the present invention entails the integration of a lubricating oil extraction process with a catalytic cracking operation by use of a novel treating process in which the extract phase of the lubricating oil extraction process is contacted with a mixture of cycle oil and heavy gas oil. The raffinate product resulting from this treating process includes constituents of the lubricating oil extract, the cycle oil, and gas oil which are suitable for catalytic cracking while eliminating inclusion of detrimental metal contaminants and refractory aromatic hydrocarbons.

As indicated, the present invention comprises a relatively complicated combination of a variety of treating steps. This combination is made in order to achieve the numerous specific objectives indicated above. In order to lay a basis for fully understanding the nature and features of this invention, attention will be directed to several aspects of the field involved.

At the present time the process of catalytic cracking is extensively employed for converting high boiling portions of a petroleum crude oil to lighter boiling commercially valuable products including gasoline and heating oils. The feed stock to a catalytic cracking unit ordinarily constitutes gas oil fractions of a petroleum crude oil boiling above the gasoline boiling range or boiling above about 430° F. It is economically desirable to include most of the highest boiling fractions of a petroleum crude oil, and for this purpose, the feed to a catalytic

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cracking unit preferably includes constituents of the crude oil boiling up to about 1100° F., or higher. As used herein, the term "gas oil" is used to identify this portion of a crude oil boiling in the range of about 430° to 1100° F. or somewhat higher.

For some time it has been appreciated that inclusion of the higher boiling portions of a crude oil in catalytic cracking feed stock causes the objectionable introduction of certain metal contaminants to the catalytic cracking zone. Among the metallic contaminants present in heavy gas oil, nickel is particularly objectionable in poisoning the catalyst used during catalytic cracking so as to decrease the selectivity and life of the catalyst. Recognizing this problem, there have been many suggestions aimed at minimizing metal contamination of gas oil catalytic cracking feed stocks. In this connection, it has been suggested that metal contaminants can be removed by contacting gas oil with a solvent such as phenol. The extraction of gas oil with phenol does result in a decrease in metal contaminants, but at an economically prohibitive cost. This results from the fact that the phenol acts as a selective solvent to remove constituents of the gas oil which are desirable for catalytic cracking as well as the undesired metal contaminants. As a result, phenol extraction of gas oil conducted to minimize metal contamination of the gas oil provides a raffinate product in yields of only about 60 to 90 volume percent, depending on the contacting conditions and the nature of the gas oil. The remainder of the gas oil is present in the extract phase resulting from this extraction process together with the organic compounds containing the metallic contaminants removed from the raffinate. Since it is desired to use the hydrocarbons present in the extract portion of the gas oil for catalytic cracking feed as well as the raffinate portion, it is apparent that this process does not provide the desired objective of separating the metal contaminants from gas oil hydrocarbons usable as catalytic cracking feed.

A basic feature involved in the present invention is the discovery that phenol can be used to selectively extract organic compounds containing metallic contaminants from a gas oil while avoiding extraction of the desirable hydrocarbon constituents of gas oil. This is possible by inclusion of high molecular weight aromatic hydrocarbons in the selective solvent-gas oil extraction system. The included high molecular weight aromatic hydrocarbons serve to displace components of gas oil normally extracted by the solvent while actually aiding extraction of metallic constituents by the selective solvent.

The precise mechanism of this process is not fully understood, but it has been found that the high molecular weight aromatic hydrocarbons present in the highest boiling fractions of catalytic cracked products provide the requisite function. Consequently, one aspect of the present invention entails the contact of a heavy gas oil with a selective solvent in the presence of aromatic hydrocarbons obtained from cycle oil derived from a catalytic cracking process. Again it has been found that aromatic hydrocarbons present in the extract phase of a lubricating oil extraction process can be used to improve extraction of metal contaminants from gas oil. In its most specific and preferred aspect, therefore, the present invention involves the contact of the gas oil with a selective solvent in the presence of aromatic hydrocarbons from both a lubricating oil extract phase and from cycle oil.

Principles of this invention are illustrated in the accompanying drawings, in which:

FIGURE 1 illustrates in diagrammatical form a preferred flow plan embodying all features of the invention.

FIGURE 2 graphically illustrates the result of extracting a gas oil with a selective solvent by itself and in the

presence of aromatic hydrocarbons obtained from the extract phase of a lubricating oil; and

FIGURE 3 graphically illustrates the results obtained in the preferred conduct of this invention entailing contact of a mixture of catalytic cycle oil and gas oil with the extract phase obtained from the solvent extraction of a lubricating oil.

Referring first to FIGURE 1 of the drawings, the processing steps involved in the practice of this invention are illustrated. In FIGURE 1, the numeral 1 designates a catalytic cracking zone. The operation conducted in zone 1 may constitute any desired type of catalytic cracking operation. Thus, the catalytic cracking may constitute the fixed bed type of cracking, moving bed type of cracking, or fluidized catalytic cracking. In each of these types of operation any of the various well known cracking catalysts may be employed. Generally, such catalysts are the metal oxide types and preferably include silica-alumina, silica-magnesia, or silica-gel promoted with metal oxides which are adsorbed thereon. Cracking conditions require maintenance of temperatures in the range of about 750° to 105° F., and pressures ranging from atmospheric to somewhat above atmospheric pressure. The catalytic agent employed is regenerated intermittently or continuously in order to restore or maintain the activity of the catalyst.

In accordance with this invention, a particular catalytic cracking feed stock as derived in the manner described hereinafter is introduced to catalytic cracking zone 1 through line 2. For the present, it is sufficient to note that the feed to catalytic cracking zone 1 generally includes a fraction of a crude oil boiling within the range of about 430° to 1100° F. For typical operation, catalytic cracking of this feed stock would result in conversion of about 50 to 60% boiling in the gasoline boiling range.

The products of catalytic cracking are removed from the catalytic cracking zone through line 3 for introduction to a product fractionator 4 which may constitute one or more distillation zones. Distillation zone 4 may be operated to permit removal of light portions of the catalytically cracked product through overhead line 5, to permit removal of gasoline through sidestream withdrawal 6, and heavier fractions of the catalytically cracked products from lower portions of the fractionator. For example, a fraction boiling above about 430° F. and boiling up to about 700° or 860° F. may be removed from the lower sidestream withdrawal 7. Heavy residual fractions of the catalytically cracked products are removed from the bottom of the fractionator through line 8. Bottoms withdrawal stream 8 will include hydrocarbons boiling above about 860° F. and boiling up to about 1150° F. In the event that powdered catalyst is employed in the catalytic cracking zone 1, some catalyst will be entrained in the bottoms withdrawal. In this case the product of line 8 may be subjected to a clarification or settling operation in order to segregate the hydrocarbons from cracking catalysts. The product of this operation is commonly called clarified oil and the stream of line 8 will be so designated herein.

The fractions of a catalytically cracked product boiling above about 430° F. are conventionally called cycle oil and in the process illustrated include the streams of both lines 7 and 8. While the process of this invention can be employed by using either the streams of line 7 or 8, the invention preferably employs both of these streams as combined in line 9 of the drawings and designated by the term "cycle oil."

It is well known that cycle oil of the character identified constitutes low grade catalytic cracking feed stock. Cycle oil particularly includes refractory high molecular weight hydrocarbons which, if recycled to a catalytic cracking operation, cause excessive formation of gas, coke and tar during catalytic cracking. The constituents of

cycle oil which are particularly objectionable for cracking are high molecular weight aromatic hydrocarbons and particularly those boiling above about 860° F. The aromatic hydrocarbons present in cycle oil include polynuclear aromatic hydrocarbons and condensed ring aromatic hydrocarbons. The condensed ring aromatic hydrocarbons are particularly undesirable for inclusion in catalytic cracking feed stock. As will be seen, the process of this invention provides a means for upgrading cycle oil for catalytic cracking by elimination of these undesirable aromatic hydrocarbon types.

In accordance with this invention, extract phase from tower 12 and line 16 enters the top of tower 11 at point A. Heavy gas oil or line 10, which may constitute the gas oil fraction of a crude oil boiling above about 430° F., is introduced into the bottom of tower 11 at point C. Cycle oil in line 9 enters tower 11 at point B, which is any place between point A and point C, or may be admixed with heavy gas oil at point D, or a portion of it may be admixed at point D with the remainder entering the tower at point B as previously described. The present invention is of particular application to heavy gas oils boiling up to 1150° F. or somewhat higher. As indicated, such gas oils are characterized by inclusion of organic compounds containing metallic contaminants such as nickel, vanadium and iron, present in amounts of about 0.00002 to 0.001 wt. percent. The process of this invention is of application to such gas oils in permitting removal of the metal contaminants referred to.

The mixture of cycle oil and heavy gas oil introduced to tower 11 is contacted with the extract phase of a lubricating oil extraction process. The required extract phase may be obtained from the process illustrated at the right of the drawings carried out in the extraction tower 12. In tower 12, a lubricating oil distillate or deasphalted oil constituting the fraction of a crude oil boiling in the range of about 700° to 1100° F. or above, is contacted with a selective solvent adapted to selectively extract aromatic constituents of the lubricating oil. Phenol is one of the selective solvents which may be employed, although other solvents are known such as furfural, nitrobenzene, aniline, cresol, etc. Anti-solvents or solvent modifiers may be used and conventionally are used in conjunction with these solvents for the extraction of a lubricating oil. For example, in the case of phenol, about 1 to 15% or somewhat higher percentages of water are preferably mixed with the phenol or separately injected during extraction, to provide the best extraction results. It is to be understood therefore, that the lubricating oil extraction process conducted in tower 12 may constitute any desired type of extraction operation.

As diagrammatically illustrated, extraction can be conducted by introducing lubricating oil at the lower portion of an extraction tower through line 13. The selective solvent, such as phenol, is introduced into the top of the extraction tower through line 14. The phenol will move downwardly through the tower countercurrent to an upwardly moving stream of lubricating oil, permitting extraction of constituents of the lubricating oil by the phenol during this contact. Perforated plates, packing, etc., may be used in the tower to aid this contacting. A raffinate phase may then be recovered from the uppermost portion of the tower and withdrawn through line 15, constituting a lubricant product. The extract phase removed from the bottom of the tower through line 16 will include the spent phenol solvent together with extracted constituents of the lubricating oil.

In this extraction process, the solvent to oil ratio will ordinarily be between about 0.5 to 1 and 3 to 1. When employing phenol or phenol-water mixtures as the selective solvent, a solvent to oil ratio of about 1 to 1 to 2 to 1 is particularly suitable. In the case of phenol extraction, the extract phase of line 16 will primarily constitute spent phenol including aromatic hydrocarbons extracted from the lubricating oil. In general, the extract phase, will

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constitute about 60 to 90% phenol and about 40 to 10% of hydrocarbons extracted from the lubricating oil feed stock. In addition, dependent on the amount of water injection, about 0.0 to 15.0% of water will be included in the extract phase.

This extract phase resulting from selective extraction of a gas oil to produce a high quality lubricating oil is usually of value as a catalytic cracking feed stock. Thus, it is known that the portion of a lubricating oil extracted by a selective solvent such as phenol is generally suitable for cracking. The extracted hydrocarbons for the most part constitute single nucleus aromatic hydrocarbons with substituted alkyl radicals which make the compound sufficiently paraffinic so that they can be attractively subjected to cracking. In the past, the extract phase from a lubricating oil extraction process has been treated so as to separate solvent from these hydrocarbons and the hydrocarbon extract is then used as catalytic cracking feed. However, the necessary solvent recovery facilities for this separation are expensive. It is one of the features of this invention, that this process can be integrated with an existing lube oil extraction plant without major additions to the facilities used to recover solvent from extract. In FIGURE 1, extract leaving tower 11 through line 18 is sent to the existing phenol recovery system used for tower 12.

The heart of the present invention concerns the operation of treating tower 11 to which is supplied the extract phase of line 16, the cycle oil stream of line 9 and the heavy gas oil stream of line 10. By introducing the mixture of cycle oil and heavy gas oil at the lower portion of tower 10, and the extract phase at the upper portion of tower 10, countercurrent treatment is secured. Phenol present in the extract phase of the lubricating oil will pass downwardly through tower 11, counterflow to an upward passage of the mixture of cycle oil and heavy gas oil. During the ensuing contact, there is a substantial transfer of hydrocarbon types. Aromatic constituents of the heavy gas oil which may be selectively extracted by phenol in the lower portion of tower 11 are desorbed in the upper portion of the tower by the hydrocarbons present in the extract phase supplied in the top of the tower. Condensed ring aromatic compounds present in the cycle oil similarly tend to desorb single ring aromatic hydrocarbons brought into the tower with the extract phase. In addition, metal contaminants introduced to the tower in the heavy gas oil are effectively scrubbed from the gas oil so as to be removable from the tower with spent solvent withdrawn at the bottom thereof. The result of the contacting treatment conducted in tower 11, permits removal of an extract phase from the bottom of the tower through line 18 constituting phenol, metallic contaminants, and aromatic hydrocarbons, particularly constituting condensed ring aromatic compounds. The raffinate stream withdrawn from the top of tower 11 through line 19 will primarily constitute hydrocarbon constituents of the lube extract, the cycle oil, and the gas oil which constitute good catalytic cracking feed stock. Thus, the raffinate will be more paraffinic in nature than the cycle oil introduced to the tower, will contain substantially less metal contaminants than the gas oil introduced to the tower and will include the hydrocarbons originally contained in the extract phase supplied to the tower.

Traces of phenol entrained in the raffinate stream of line 19 may be removed from the raffinate by distillation in fractionation zone 20. The phenol may be removed overhead through line 21 while dephenolized raffinate will be removed from the bottom of tower 20 through line 2. It is this raffinate which is supplied to catalytic cracking zone 1 as the feed to this zone.

It will be seen that the process described employs a novel treating operation for concomitant contact of the extract phase of a lubricating oil extraction process, a heavy gas oil containing metal contaminants and a cycle oil containing aromatic hydrocarbons which are not

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adaptable for cracking. The single treating operation conducted serves to remove metal contaminants from the raffinate product, serves to recover crackable constituents originally present in the extract phase, and serves to upgrade cycle oil for catalytic cracking.

In order to bring out the unique features and advantages of the process described, reference is made to exemplary data obtained in evaluating the process of this invention. In a first series of tests which were conducted, experiments were carried out to evaluate the effect of contacting a gas oil with a selective solvent in the presence of high molecular weight aromatic hydrocarbons. The heavy gas oil was derived from a South Louisiana crude oil and had the following inspections:

TABLE I

Gravity, ° API	21.2
Viscosity SSU/210° F.	116
Conradson carbon, wt. percent	2.29
Sulphur, wt. percent	0.39
Metal content:	
Nickel, p.p.m.	2.1
Vanadium, p.p.m.	0.3
Iron, p.p.m.	1.7
Silica gel analysis:	
Aromatics, wt. percent	39.9
Paraffins, wt. percent	60.1
Aromatic index	16.8

In one series of experiments which were conducted, the total extract phase from a lubricating oil extraction operation was employed as the source of the selective solvent.

The lubricating oil distillate which was phenol extracted was produced from a blend of distillates obtained from Talco and North Louisiana crudes. A typical range of inspections follow for this stream:

Gravity, °API	26.5-27.5
Viscosity, SSU/210° F.	39 - 42
Aniline point, °F.	185 -195
Diesel index	49 - 54

This distillate was treated with phenol in a countercurrent extraction tower providing about 5 theoretical stages. The feed rates were about 12,300 b./s.d. of phenol and about 7,450 b./s.d. of lube distillate to provide a phenol treat of 165%. Water injection was maintained during extraction to provide a total injection amount of about 2.5%, based on the phenol. The extraction temperature was about 145° F.

The extract phase obtained from this operation, constituted 84% phenol; 2% water, and 14% hydrocarbons extracted from the lubricating oil feed. The hydrocarbon constituents of the extract phase were primarily mononuclear aromatic compounds having substantial alkyl side chain substitution. Phenol was separated from a portion of this extract phase and it was found that the hydrocarbon constituents of the extract phase had the following inspections:

Gravity, °API	19.0
Viscosity, SSU/210° F.	48.5
Silica gel Analysis:	
Aromatics, wt. percent	62.1
Paraffins, wt. percent	37.9
Aromatic index	32.9
Naphthenic index	10.4
Conradson carbon, wt. percent	0.5

The gas oil identified was extracted with this lubricating oil extract phase and with fresh phenol solvent in comparative extraction tests operated at about 160° F. The conduct of these extraction tests and the results of them are shown in Table II.

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TABLE II

Nickel Removal From Gas-Oil by Phenol Extraction

	Fresh phenol	Lube oil extract phase
Operating conditions:		
Phenol treat, vol. percent.....	98	96
Water injection, vol. percent <sup>1</sup> .....	9.7	11.0
Total oil feed blend:		
Gravity, °API.....	21.2	20.8
Conradson carbon, weight percent.....	2.3	2.01
Sulfur, weight percent.....	0.39	0.72
Nickel, p.p.m.....	2.1	1.91
Aromatic index.....	16.8	-----
Naphthene index.....	21.6	-----
Dephenolized raffinate oil:		
Yield on total oil, vol. percent.....	75	84.1
Gravity, °API.....	23.5	23.1
Conradson carbon, weight percent.....	1.4	0.74
Sulfur, weight percent.....	0.33	0.84
Nickel, p.p.m.....	0.64	0.32
Aromatic index.....	16.1	16.9
Naphthene index.....	20.5	21.6
Extract oil:		
Gravity, °API.....	Ca 10	9.7
Conradson carbon, weight percent.....	10.88	6.04
Sulfur, weight percent.....	1.03	1.50
Nickel, p.p.m. ± 1.....	7.1	-----
Removals:		
Ni from cat. cracking feed, weight percent.....	77	86
Conradson carbon, weight percent.....	51.3	69.8
Sulfur, weight percent.....	37.4	4.0

<sup>1</sup> Volume percent water expressed as percent of phenol.  
<sup>2</sup> Includes oil in spent phenol.

The results shown in Table II establish the fact that extraction of gas oil is substantially improved by inclu-

lubricating oil extract phase. In these experiments, the gas oil was that identified in Table I.

The clarified oil was obtained from the catalytic cracking of a gas oil boiling in the range of about 430° to 1150° conducted so as to secure about 60% conversion to gasoline. In these experiments lubricating oil extract phase derived from the solvent extraction of a 100 neutral lubricating oil was employed. This extract phase constituted 18% hydrocarbons and 82% phenol. The inspections of the clarified oil and the hydrocarbons present in the extract phase were as follows:

TABLE III

	Oil in extract phase	Clarified oil
Gravity, °API.....	17.6	20.0
Viscosity, SSU/210° F.....	46	39
Conradson carbon, weight percent.....	0.1	1.6
Sulfur, weight percent.....	1.72	0.72
Nickel content, p.p.m.....	0.15	<0.05
Silica gel analysis:		
Aromatics, weight percent.....	65	47.2
Paraffins, weight percent.....	35	52.8
Aromatic index.....	39.0	38.3
Naphthene index.....	10.9	12.4

Different mixtures of the clarified oil and cycle stock were extracted with the lubricating oil extract phase at a temperature of about 160° F. in a manner providing about five contacting stages. The extraction conditions and the results secured are summarized in Table IV.

TABLE IV

Extraction of Mixtures of Gas Oil and Clarified Oil

Feed stock—percent gas oil..... percent clarified oil.....	67 33				50 50		33 67	
Operating conditions:								
Spent phenol treat, vol. percent.....	106	100	100	99	108	96	97	
Water injection, <sup>1</sup> vol. percent.....	10.1	5.8	2.2	0	10.2	10.3	2.3	
Total oil feed blend: <sup>2</sup>								
Gravity, °API.....	20.6	20.6	19.9	19.9	20.3	18.9	18.9	
Conradson carbon, weight percent.....	1.80	1.80	2.36	2.36	1.82	2.30	2.30	
Sulfur, weight percent.....	0.64	0.64	0.68	0.68	0.68	0.75	0.75	
Nickel, p.p.m.....	1.26	1.26	1.27	1.27	0.95	0.64	0.64	
Aromatic index.....	-----	-----	-----	-----	-----	-----	-----	
Naphthene index.....	-----	-----	-----	-----	-----	-----	-----	
Dephenolized raffinate oil:								
Yield on total oil, vol. percent.....	88.7	83.7	71.2	58.6	84.6	80.7	62.5	
Equiv. yield of crack. feed.....	100	94	82	66	103	118	89	
Gravity, °API.....	23.6	25.0	26.2	27.1	25.0	24.6	28.6	
Conradson carbon, weight percent.....	1.0	0.67	0.45	0.26	0.87	1.07	0.30	
Sulfur, weight percent.....	0.68	0.51	0.41	0.36	0.55	0.67	0.44	
Nickel, p.p.m.....	0.40	0.24	0.20	0.18	0.32	0.38	0.11	
Aromatic index.....	19.0	17.1	12.3	13.2	17.4	17.0	13.8	
Naphthene index.....	17.6	17.4	18.4	16.3	17.9	17.0	20.2	
Extract oil:								
Gravity, °API.....	0.2	1.5	6.3	10.7	-0.6	-1.1	5.1	
Conradson carbon, weight percent.....	7.72	7.40	6.1	5.7	6.92	8.10	6.5	
Sulfur, weight percent.....	1.02	1.25	1.13	1.03	1.30	1.39	1.12	
Nickel, p.p.m. plus or minus 1.....	6.8	5.6	4.9	4.9	4.6	3.1	2.5	
Removals:								
Ni from cat. crack. feed, weight percent.....	72.4	84.4	90.5	92.0	72.3	53.9	89.6	
Conradson carbon, weight percent.....	51.8	69.9	87.0	93.8	62.5	63.8	89.6	
Sulfur, weight percent.....	21.3	35.6	59.0	70.4	36.4	27.7	54.4	

<sup>1</sup> Vol. percent water expressed as percent of phenol.  
<sup>2</sup> Includes oil in spent phenol, heavy gas oil, and clarified oil.

sion of high molecular weight aromatic hydrocarbons, in this case derived from lubricating oil. This is particularly illustrated in FIGURE 2 of the drawings, based on this and similar data showing the extent of metal removal achieved by extraction of gas oil with: (a) phenol including aromatic hydrocarbons extracted from lubricating oil, and (b) phenol by itself. The data particularly shows that the extract phase of a lubricating oil extraction process is a better agent for removing metal contaminants from gas oil than a selective solvent by itself. For this reason, use of such an extract phase is preferred in the practice of this invention and will be particularly referred to in the data which follows:

Another series of experiments was conducted to evaluate the precise flow plan illustrated in FIGURE 1 involving contact of a heavy gas oil with both cycle oil and a

In this table the "Equivalent Yield of Cracking Feed" is determined by the formula

$$\frac{V_1 - V_2}{V_3}$$

where:

V<sub>1</sub>—Total volume of raffinate obtained during a run.

V<sub>2</sub>—The estimated volume of raffinate that would be obtained if the clarified oil portion of the feed were extracted separately under the same conditions.

V<sub>3</sub>—Volume of heavy gas oil plus volume of oil associated with the lube-oil spent phenol.

The most significant data of Table IV is represented graphically in FIGURE 3 of the drawings. It is there shown that the removal of metal contaminants from gas

oil is improved to provide greater yields of cracking feed by inclusion of clarified oil in admixture with the gas oil. In considering the relative proportions of clarified oil and gas oil, it is shown that increasing the proportion of the clarified oil in the mixture provides better extraction results.

As established, therefore, the present invention broadly concerns the process of extracting a gas oil fraction of petroleum employing a selective solvent for aromatic hydrocarbons in the presence of or admixed with extraneously introduced aromatic hydrocarbons derived from petroleum fractions boiling above about 430° F. Inclusion of such aromatic hydrocarbons can be achieved by admixing cycle oil from catalytic cracking with the gas oil. Alternatively, or preferably in addition to this, aromatic hydrocarbons can be derived from the lubricating oil fraction of a gas oil in order to aid the extraction of gas oil. This is preferably achieved by employing the total extract phase of a prior lubricating oil extraction process for the extraction of gas oil.

What is claimed is:

1. A process for the preparation of catalytic cracking feed stocks which comprises contacting a lubricating oil distillate containing aromatic hydrocarbons with a selective solvent for aromatic hydrocarbons to form a first extract phase containing said solvent and aromatic hydrocarbons, contacting said first extract phase with a heavy gas oil containing constituents boiling above about 1100° F., metal contaminants, and admixed cycle oil, to form a second extract phase containing metal contaminants derived from said heavy gas oil and a raffinate phase, and removing the solvent from said raffinate phase.

2. A process as defined in claim 1 wherein said selective solvent for aromatic hydrocarbons is phenol.

3. A method of pretreating a mixture of cycle oil and heavy gas oil for subsequent catalytic cracking, said mixture containing constituents boiling above about 1100° F. and containing metal contaminants, which comprises contacting a lubricating oil distillate containing aromatic hydrocarbons with phenol to form a first extract phase containing phenol and aromatic hydrocarbons, contacting said first extract phase with said mixture of cycle oil and heavy gas oil to form a second extract phase containing metal contaminants derived from said mixture

and a raffinate phase, and removing phenol from said raffinate phase.

4. A process for the preparation of catalytic cracking feed stocks which comprises contacting a lubricating oil distillate containing aromatic hydrocarbons with phenol to form a first extract phase containing phenol and aromatic hydrocarbons, contacting said first extract phase with a heavy gas oil in the presence of a cycle oil, said heavy gas oil containing constituents boiling above about 1100° F. and containing metal contaminants to form a second extract phase containing metal contaminants derived from said heavy gas oil and a raffinate phase, and removing the phenol from the raffinate phase.

5. A process for refining a heavy gas oil fraction containing constituents boiling above about 1100° F. and containing metal contaminants which comprises in combination contacting a lubricating oil distillate containing aromatic hydrocarbons with phenol to form an extract phase, contacting the heavy gas oil fraction with said extract phase in the presence of a cycle oil to form a raffinate fraction substantially free from said metal contaminants, thereafter segregating and catalytically cracking the hydrocarbons in said raffinate phase.

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