
Refinery Stream Speciation

REGULATORY ANALYSIS AND SCIENTIFIC AFFAIRS
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REFINERY STREAM SPECIATION

PERF COOPERATIVE AIR PROGRAM PROJECT 94-05-06

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EXECUTIVE SUMMARY

This report contains the results of a study to determine the range of compositions for a number of compounds in typical refinery process streams. Data representing 31 refineries, over 20 processes, and over 50 process streams was contributed by the project participants: Amoco, Arco, BP, Chevron, Exxon, Mobil, Shell and Texaco. **The results of this project will be of use in estimating the emissions of specific compounds, in preparing permit applications and in other environmental control activities. Neither the Petroleum Environmental Research Forum (PERF) or the project participants make any claims as to the suitability or acceptability of the stream composition data reported herein for specific reporting or regulatory purposes.**

This project was undertaken to provide an improved database for determining the composition and estimating the emissions of 24 regulated compounds from typical refinery process streams. Some of these compounds are included in the 1990 Clean Air Act Amendments Title III List of Hazardous Air Pollutants and the others are among those compounds to be regulated under the Accidental Release provisions of Title III. The results presented in this report represent a larger quantity of data than that available to any of the participant individually and will, therefore, result in improved emission estimates and a better understanding of the variability in process stream compositions.

Concentrations of specific compounds are presented both in tabular form and graphically. For each process unit and stream, the data include the minimum, maximum and most likely concentrations for each compound. A second listing presents the data by compound so that potential emission sources can be more easily identified and evaluated. The data are presented graphically by process unit and stream, showing all of the data and the most likely value for each compound. This graphical presentation illustrates the large degree of variability of much of the data. Details of the data collection, review and analysis procedures are also included in the report.

Operations within a refinery are primarily monitored and controlled based on physical properties such as temperature rather than by process stream concentrations of specific compounds. Thus, the range of compositions in a specific process stream may vary widely depending on the particular crude oil, product slate, processing severity, and other factors. The range of the process stream concentration values for a specific compound should be considered in application of the means and most likely values provided in this report.

INTRODUCTION AND BACKGROUND

Passage of the Clean Air Act Amendments of 1990 created a number of new compliance challenges for the U.S. petroleum industry. In order to provide improved approaches to meeting these challenges, and to allow leveraging of research expenditures, a number of the members of the Petroleum Environmental Research Forum (PERF) formed the Cooperative Air Program (CAP). The CAP consists of a number of individual research projects in twelve areas including emissions monitoring, dispersion modeling, VOC and NO_x emission control, pollution prevention and others. Refinery stream speciation is one of the CAP project areas.

The objective of the refinery stream speciation project was to develop industry representative concentration profiles for process streams. Reasons for undertaking this activity included the desire for improved emissions estimates for determination of regulatory applicability, operating permit preparation and compliance, and risk assessment determinations. There was concern that the previously available speciation data was not representative of averages or the ranges of specific compounds in current refinery operations.

The refinery stream speciation profiles presented in this document were developed from stream sampling conducted by each of the participating companies: Amoco, Arco, BP, Chevron, Exxon, Mobil, Shell and Texaco. The identities of specific companies and refineries are coded in the raw data listing for confidentiality. Each company representative provided guidance on the program scope and objectives, the data collection effort, the data analysis procedures, and the reporting of final results.

The results of this report are based on analyses from 31 refineries, over 20 units, and over 50 process streams. One of the most significant observations is the wide range of the reported concentrations for some of the compounds. This is believed to be a result of the way crude oil is converted into useful products and how refinery process units operate. These process units usually monitor and control operations based on physical properties such as temperature rather than by the concentrations of specific compounds. Thus, the range of compositions in a specific process stream may vary widely depending on the particular crude oil, product slate, processing severity, and other factors. This range of process stream concentration should be considered in application of the means and most likely values provided in this report.

This report is divided into a number of sections which describe the data collection and analysis procedures, contain tables of stream compositions and the raw data, and provide a graphical presentation of the data.

Section 3 provides a summary of the data collection and analysis effort.

Section 4 contains a listing of the process units and streams, simplified flow diagrams, and the compounds included in the study.

Section 5 presents the stream composition data in tabular form. First, for each process unit and stream, the minimum, maximum and most likely values of the concentration of each compound are presented. This is followed by a table listing the data by compound. A third table provides additional statistical information from the analysis.

Section 6 is a listing of the raw data. Participating companies have been provided with an electronic version of this spreadsheet.

Section 7 provides details of the data collection and handling, statistical analysis, and a discussion relating to the analytical sampling.

Section 8 is a graphical presentation of the data by process unit and stream showing all data and the most likely value.

The material contained in this report will be of use in estimating the emissions of specific compounds, in preparing permit applications and in other environmental control activities. Neither PERF or the project participants make any claims as to the suitability or acceptability of the stream composition data reported herein for specific reporting or regulatory purposes.

Section 3

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PROCEDURES SUMMARY

In order to effectively collect information on stream composition, the participants had to decide on a number of issues prior to collection of data. Process units were selected, a process streams naming convention was developed and a target compound list was agreed upon. These procedures are described in Section 4.

From the agreed upon list of process units, streams and selected species, a Microsoft Excel spreadsheet template was developed and mailed to each participant. Each individual company was responsible for collecting the data from internal sources.

Confidential Company Codes/Data Identification

To ensure confidentiality, a unique alphabet code was assigned to each company. This code was known only to the data project coordinator and the individual company submitting the data. Number suffixes were used to identify individual process units for each company. For example, if company "A" operates 3 refineries with a total of 4 reformers, the data from those units will be identified as A-1, A-2, A-3 and A-4. The data collection template also made provisions for individual refineries to keep track of their own local stream names in addition to the agreed generic convention name so that each site could keep track of their own data, if so desired.

Data Quality Codes

Participants were asked to assign data quality letter codes "A" through "D" in accordance with EPA's "FIRE" rating scheme. A description of these codes is included in Appendix 2 of this report. The data quality ranged from "A" type (tests performed by sound method and reported with enough detail for validation) through "D" type (approximate data or obtained by unknown procedures). A separate code was included for process knowledge or engineering judgement (EJ) estimates.

Reporting Limits

For all the data reported as not detected (ND), participants were asked to provide the actual detection/reporting limit (if known) used by the laboratory. This information on the detection/reporting limit was included in the Excel cell notes as comments on the data collection spreadsheet. For the initial analysis only, the participants agreed to adopt the April 1993 CARB conventions on "Reporting Emissions Derived from Below the Limit of Detection Source Test Results". In this approach, if all occurrences for a given hazardous air pollutant (HAP) in a given stream is ND, zero is used in emissions calculations; if even one occurrence is above ND, then half of the reporting limit value is used in place of all NDs for emissions calculations. Since the data had many sources, was obtained from different methods and the samples had such variable matrices, the reporting limits varied significantly.

For the final summary data tables and statistics reported in Section 5, a single cutoff value of 0.01% was used as a reporting limit for each species. This approach is discussed in the analytical section in Appendix 2.

Data Compilation and Validation

Once all of the individual data spreadsheets were obtained, the data were combined into a single large spreadsheet, sorted in stream order (all the data for one stream from all companies gathered together), and a preliminary draft data summary as well as all of the coded data were issued for review by the participants. This initial data summary included minimum, maximum, median and averages. The database and summary were provided on diskettes along with guidelines as to how to properly flag corrections. These corrections and questions were returned in diskette form. The corrections and questions were merged into the database and the review process was repeated. There were several iterations of data review/validation.

The validation process included a comparison of each company's HAPs data to the average of all companies' HAPs data for each HAP in a given stream. Each participant also provided comments on the other companies' data.

The data review also included ranking of the data in a scale of 1 to 4 (1=definite inclusion; 4=definite exclusion). Each participant was expected to rank the data. In general, data with a higher quality coding (described in Appendix 2) would rank higher, but visual inspection of consistency and technical judgment was also used.

In some cases, review of the data resulted in elimination of an individual datapoint (one species value) from the spreadsheet as well as removal of a complete data set (all species values for one stream) from the spreadsheet. These types of decisions were made on a case by case basis. Some of the data for streams that were removed from the database were rejected because they were most likely not of the right stream classification.

The participants chose to remove "EJ" type data from the summary table and not to include this type of data in the statistics. The "EJ" type data were only kept in the raw data spreadsheet.

After several such technical reviews, the data were statistically evaluated. The results of this evaluation are included in this report.

Section 4

STREAM AND PROCESS DESCRIPTION

SELECTION OF PROCESS UNITS

As previously stated, crude oil is a highly variable complex mixture. Refinery operations are very diverse in terms of processing and conversion units as well as operational variability. The intended use of most refinery intermediates and end products is performance based, not compound specific. Most major refineries have crude distillation units (atmospheric and vacuum), gas plants, conversion units (such as hydrocracking and reforming) and stream/product treating units (caustic, acid and hydrotreating). However, no two refineries operate any of these units in exactly the same way. The process streams are separated into different cuts (boiling ranges) and are routed to other units for further conversion or treating in an integrated refinery. Different companies may have different names for identical processing units. Regardless of how or what the refinery units may be called by any given company for any particular refinery, there are several major units that are common to most major refineries. The PERF participants agreed on the major units that represent the major refinery processes for inclusion in this study. These units are listed in Table 4-1 along with the process stream names chosen. It was agreed to exclude petrochemical and lube production units since these units are not present in all refineries and are even more variable in configuration and operation. The names chosen are the simplest and most common names used at US refineries.

SELECTION OF PROCESS STREAMS AND STREAM NAMING CONVENTION

Before any information could be gathered on stream composition, it was necessary to agree upon a stream naming convention. There are several reasons why this is a very critical step in the data gathering process. Names for the same type of stream from a similar unit may be different from one refinery to the next. For example, the same cut from a crude distillation unit may be called "straight run" naphtha at one location and "virgin" naphtha at another site. A much more difficult problem is the way streams are "cut" or the boiling ranges for the particular stream. A refiner may choose to produce a single stream out of a reformer or may choose to split the reformer output into two boiling ranges. In one case only a "reformate" is produced whereas in another case, there could be a "light" and a "heavy" reformate. These streams can be quite variable in composition with one having significant concentrations of benzene and another with little or no benzene. Additional variability could be encountered depending on the boiling range or carbon number range of the feed to the reformer.

An attempt was made to use the CAS stream identifications that are included in the TSCA inventory of petroleum process streams published by API in 1983. This document lists streams from the process units from which they are derived and are organized in

descending volatility or ascending order of carbon number. The process streams included in the 1983 API report were those that have been reported to EPA as being in commercial production since 1975. However, it was not possible to use this classification scheme since there were too many narrowly defined streams with overlapping carbon ranges. For example, a reformer stream may not always contain hydrocarbons in the C5 to C11 range or the C4 to C12 range at any one time. These two carbon ranges have different CAS numbers. It would also be very difficult to determine if, when the HAP data was obtained, the particular stream was in the C5 to C11 range or the C4 to C12 range. In some cases there are two streams with the same carbon and boiling range and with two different CAS numbers.

The number of streams for any given unit in the TSCA report is overwhelming and many of the streams should have been combined. There are twenty one liquid streams and thirty eight gas streams listed for the atmospheric distillation unit and fifteen liquid streams listed for the vacuum distillation unit. Refineries do not operate this way and there would be no data available with such narrowly defined and overlapping ranges. The only workable alternative for this PERF project was to simplify the number of streams for any given unit and acknowledge the fact that there would be a range in composition for any given stream.

Even with this simple naming scheme used in this study, some “light” and “heavy” streams could have been combined because in some cases the streams’ physical properties may not have been adequately described for the data gatherer to know the exact boiling range of the stream. In addition, some refineries may have just one stream of a given type or may produce “light”, “medium”, “heavy” and “extra heavy” streams. Placing this type of data in the database added additional variability. The streams included in this report are summarized in Table 5-1 listed under the process units from which they are derived. The corresponding generic refinery streams flow diagrams are included in Figures 1 - 16. Figure 17 is an example of an integrated refinery.

TABLE 4-1**REFINERY PROCESS UNITS AND STREAM NAMES**

From Unit Process Units	Stream Name Process Streams	From Unit Process Units	Stream Name Process Streams
Supply System	Crude Oil	Hydrodesulfurization	Naphtha
Atmospheric Distillation	Atmospheric Residue		Jet/Kerosene
	Heavy Atmospheric Gas Oil		Diesel
	Light Atmospheric Gas Oil		Heating Oil
	Straight Run Kerosene	Alkylation	Alkylate
	Heavy Naphtha		Butane
	Straight Run Naphtha		LPG
	Light Ends	Sat. Gas Plant	Sat. gas
Vacuum Distillation	Vacuum Resid	Catalytic Isomerization	Isomerization Naphtha
	Heavy Vacuum Gas Oil		Isobutane
	Light Vacuum Gas Oil	Spent caustic	Spent caustic
	Vacuum Naphtha	Sulfur Plant	Fuel gas
Asphalt Plant	Asphalt	Sour Water Stripper	Stripped Sour Water
	Used Solvent	Amine treating	Treated Olefinic
Visbreaker	Cracked Residue		Sour Gas
Resid Hydroprocessing	Hydroprocessed Resid	Naphtha Pretreating	Desulfurized Naphtha
Coker	Coke	Catalytic Reformer	Reformate
	Coker Gas Oil		Reformate gas
	Coker Heavy Naphtha	Aromatics Extraction	Benzene
	Coker Light Naphtha		Toluene
	Unsaturated Gas		Xylenes
Polymerization	Polymerization Naphtha		Heavy Aromatics
	Propane	Various Units	Slop Oil
	Butane		
Catalytic Hydrocracker	Heavy Hydrocracked Distillates	<u>Refined Products :</u>	
	Light Hydrocracked Distillates	Kerosene Treating	Commercial Jet Fuel
	Heavy Hydrocracked Naphtha	Gasoline Blending	Conventional Gasoline
	Light Hydrocracked Naphtha	Gasoline Blending	Aviation Gasoline
	Saturated Gas	Gasoline Blending	Reformulated gasoline
Catalytic Hydrotreater	Catalytic Cracker Feed	Distillate Blending	Diesel Fuel
Catalytic Cracker	Heavy Cat. Cracked Gas Oil	Distillate Blending	Home Heating Oil
	Light Cat. Cracked Gas Oil	Lube Unit	Solvent-Refined Lubes
	Cat. Cracked Gasoline	Lube Unit	Hydro-Refined Lubes
Cracked Gas Plant	Unsaturated Gas		
	Fuel gas		
	Sour gas		
	Olefins		


Documents

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SELECTION OF HAPS PERTINENT TO REFINERY OPERATIONS

The Clean Air Act Amendments of 1990 lists 189 compounds as Hazardous Air Pollutants (HAPs). However, many of these compounds such as pesticides, herbicides and halocarbons are not present in crude oil refining. The entire HAPs list was considered by all project members including consultations with refinery operations experts at each company. The short list for data sharing was developed by consensus based on process knowledge and experience. In addition to the eighteen HAPs, there were also six additional compounds added to the list. These additional compounds are of interest for Accidental Release modeling. The HAPs and accidental release compounds included in this study are listed in Table 4-2.

A class of compounds called "Polycyclic Organic Matter" is included as a HAP under the CAA Amendments. Although some compounds that belong to this class are expected to be present in crude oil and some refinery streams and products, the participants opted not to include this type of compounds in this study because POMs are poorly defined in the CAA Amendments and there is virtually no data available as a class or as individual species. In addition, target analytes within that class would have to be identified before any data could be collected.

TABLE 4-2

SELECTION OF HAPs: HAPs that could be found in petroleum and its products

HAPs

1,3-Butadiene	Methyl ethyl ketone
Benzene	Methyl-tert-butylether
Biphenyl	Naphthalene
Cresols	Phenol
Cumene	Styrene
Ethylbenzene	1,2,4-Trimethylbenzene
Ethylene glycol	2,2,4-Trimethylpentane
n-Hexane	Toluene
Methanol	Xylenes

Accidental Releases

Ethane
Ethylene
Propane
Propylene
Butane
Hydrogen Sulfide

FIGURE 1

ATMOSPHERIC & VACUUM DISTILLATION UNITS

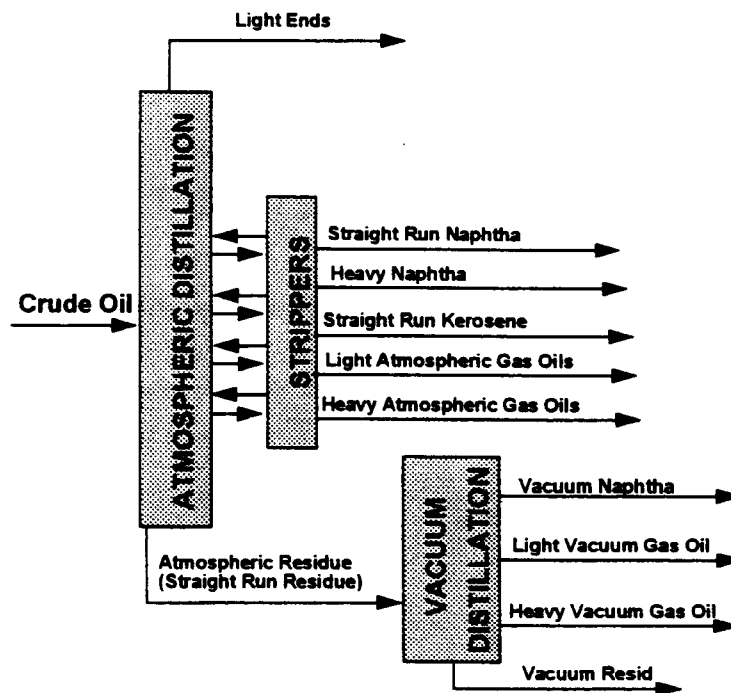


FIGURE 2
ASPHALT PLANT

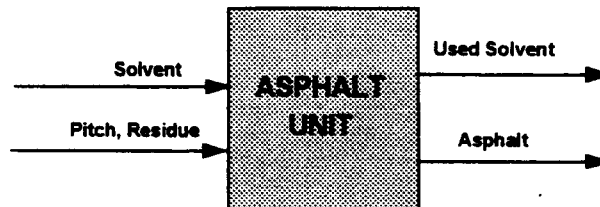


FIGURE 3

VISBREAKER

Viscosity breaking is a mild cracking operation used to reduce the viscosity of residues. Usually to make MFO (+ Cutter stock)

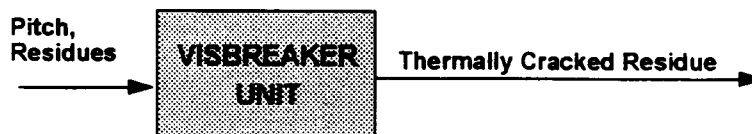


FIGURE 4

RESID HYDROPROCESSING

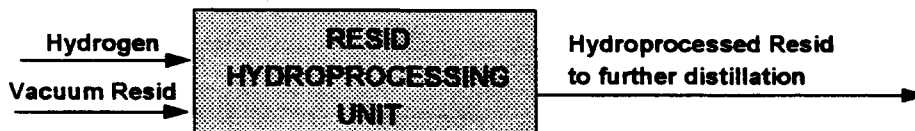


FIGURE 5

COKER

Thermal process for conversion of heavy oils and pitch into lighter products.

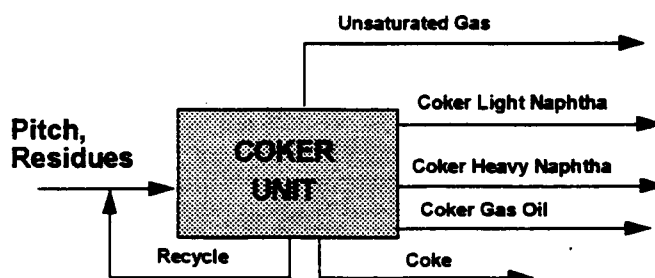


FIGURE 6 POLYMERIZATION

Conversion of small olefins to longer olefins

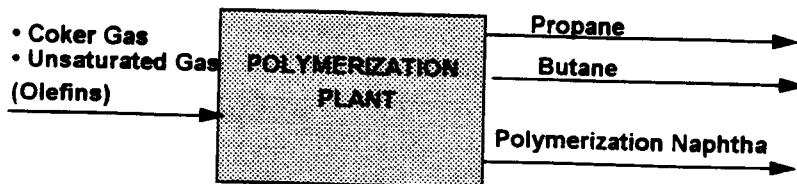


FIGURE 7 CATALYTIC HYDROCRACKING

Large hydrocarbons are converted to smaller saturates.

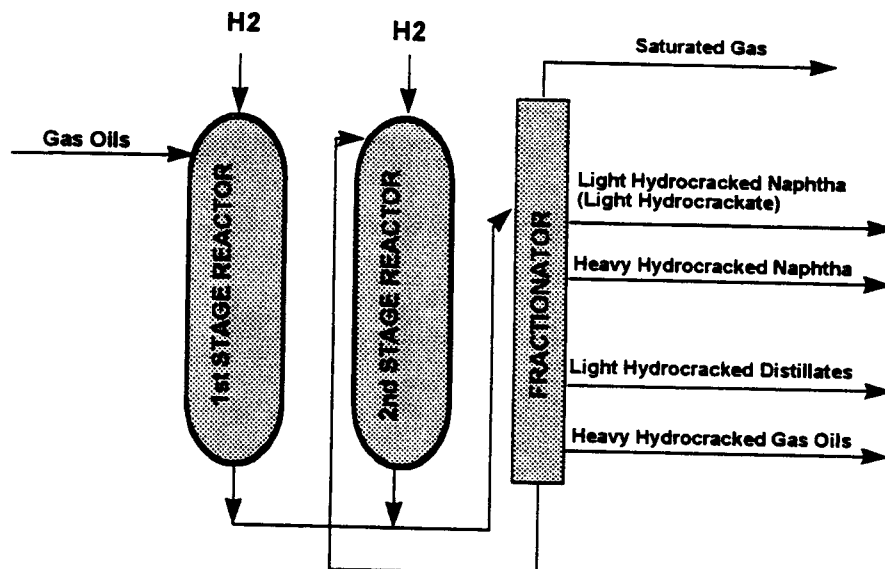


FIGURE 8 CATALYTIC HYDROTREATER

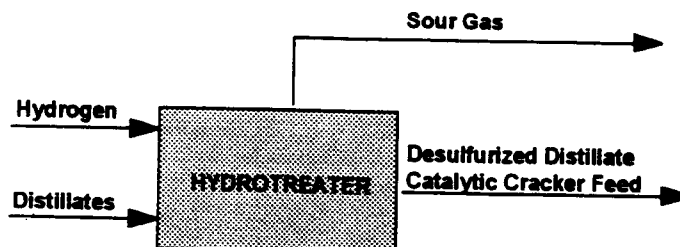


FIGURE 9 CATALYTIC CRACKER

Highest throughput of the refinery after the crude unit (30-40% basis crude)
Large hydrocarbons are converted to smaller aromatics, olefins isoparaffins, naphthenes.

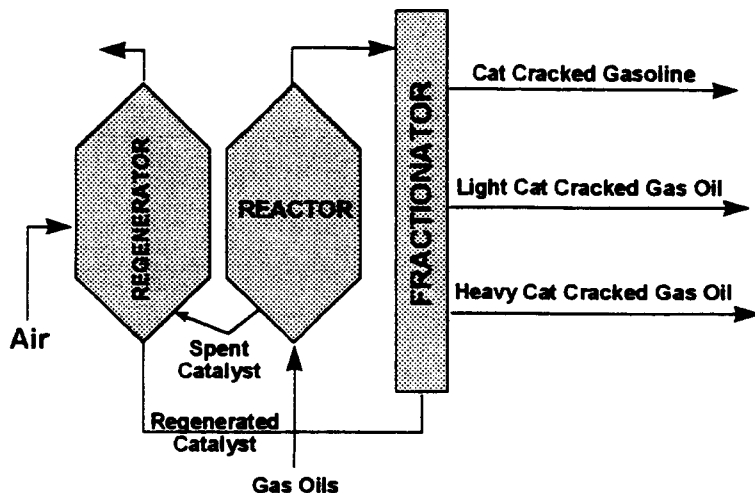


FIGURE 10 CRACKED GAS PLANT

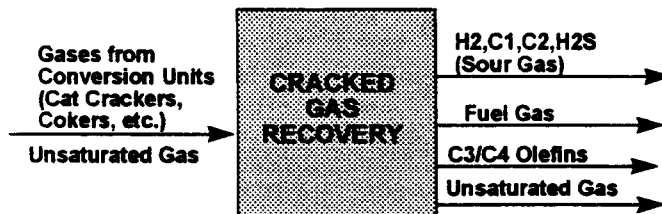


FIGURE 11 HYDRODESULFURIZATION

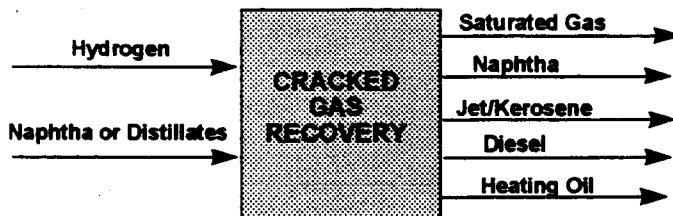


FIGURE 12

ALKYLATION

The tertiary carbon of an isobutane molecule is joined to the double bond of an olefin molecule in the presence of acid catalyst (HF or H₂SO₄). Depending on the exact carbon number (3, 4, or 5) and isomer configuration of the olefin molecule, the result is a branched chain isoparaffin of carbon number 7, 8, or 9.

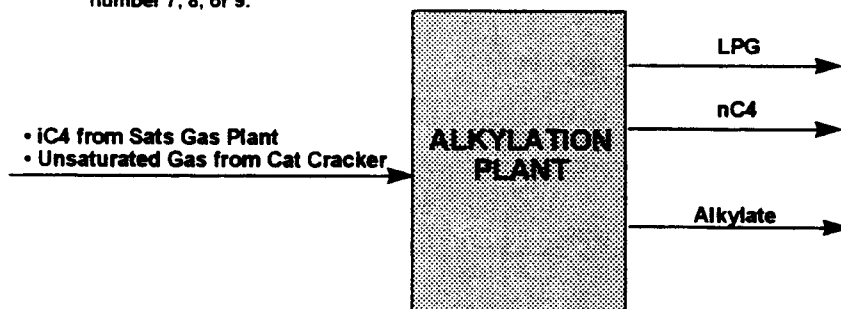


FIGURE 13

SATS GAS PLANT

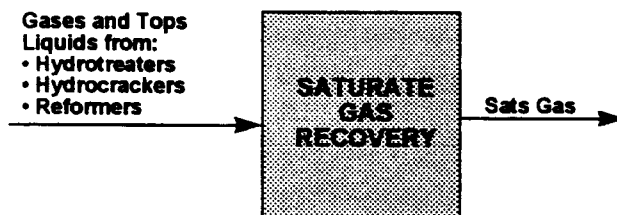
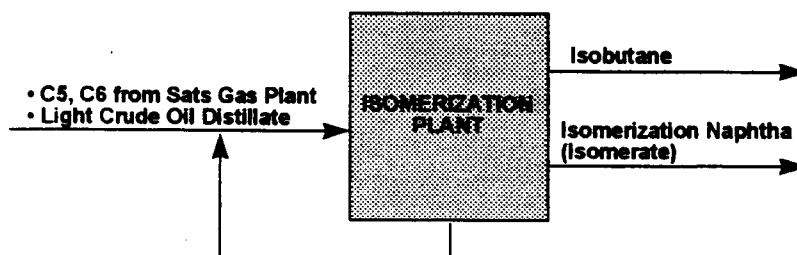
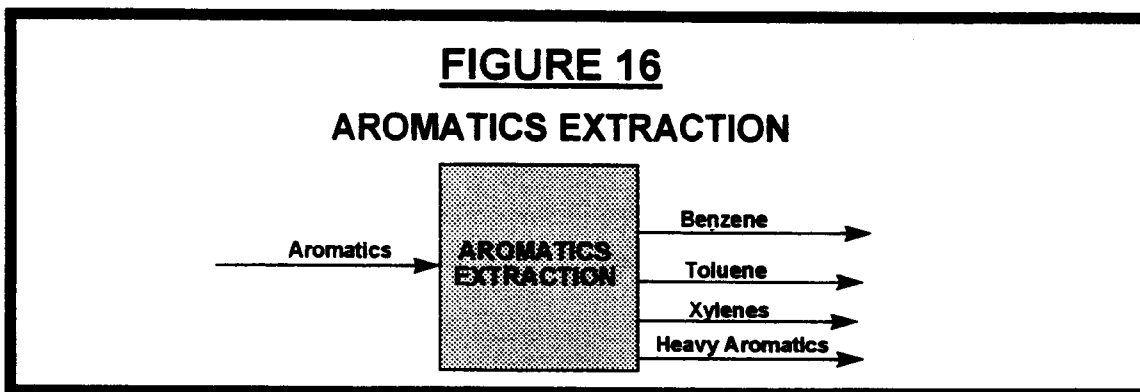
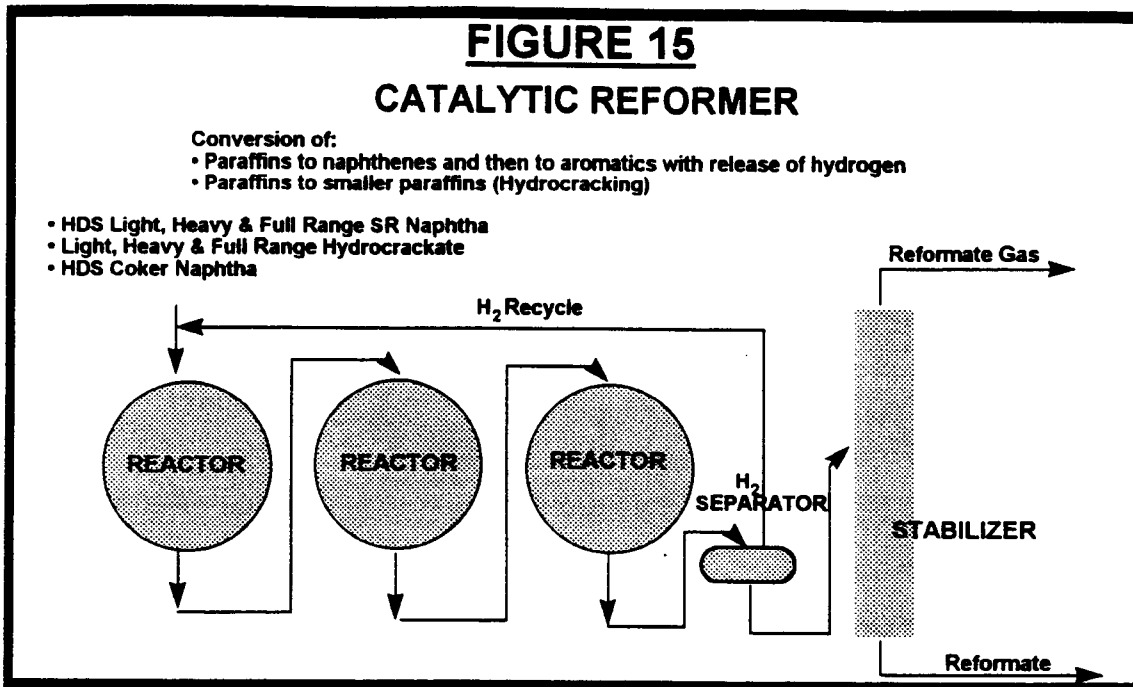


FIGURE 14

CATALYTIC ISOMERIZATION

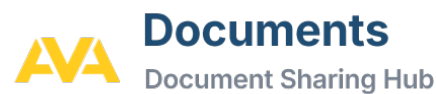
Conversion of normal paraffins to isoparaffins





FLOW DIAGRAM OF A COMPLEX U.S. REFINERY

(Source: "Standard Definitions for Petroleum Statistics", **API**, Technical Report No. 1, 4th Edition, 1988)



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Section 5

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SUMMARY STREAM COMPOSITION DATA

SECTION 5 CONTAINS 2 TABLES:

- A. COMPOSITIONS LISTED BY REFINERY UNIT AND STREAM**
- B. COMPOSITIONS LISTED BY HAP**

DEFINITIONS:

Number data	Total number of data submissions
Number quantified	Number of data submissions that were not ND
Minimum value	Lowest submitted value of concentration (wt. %)
Maximum value	Highest submitted value of concentration (wt. %)
Most likely value	Most probable value based on a log mean distribution censored at the ND value (wt. %)
ND	Non-detect, including values detected at below the reasonable non-detect level.

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Alkylation REF_STRM=Alkylate from C4 Olefin Feed -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	4	1	ND	0.10	0.018
biphenyl	1	0	ND	ND	ND
butadiene 1,3	1	0	ND	ND	ND
cumene	1	0	ND	ND	ND
ethylbenzene	1	0	ND	ND	ND
methanol	1	0	ND	ND	ND
n_hexane	5	3	ND	5.90	0.255
naphthalene	1	0	ND	ND	ND
phenol	1	0	ND	ND	ND
styrene	1	1	0.02	0.02	0.020
tmb 1,2,4	1	0	ND	ND	ND
tmp 2,2,4	9	9	12.10	36.40	23.839
toluene	5	4	ND	6.12	0.335
xlenes	4	2	ND	0.20	0.034
z_ethylene	1	0	ND	ND	ND
z_propane	1	0	ND	ND	ND
z_propylene	1	0	ND	ND	ND
zz_butane	6	6	0.30	9.23	3.205

-----REF_UNIT=Alkylation REF_STRM=Alkylate-not from C4 Olefin Feed -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	7	0	ND	ND	ND
biphenyl	1	1	0.05	0.05	0.050
butadiene 1,3	3	0	ND	ND	ND
cumene	7	0	ND	ND	ND
ethylbenzene	4	0	ND	ND	ND
methanol	1	0	ND	ND	ND
n_hexane	4	3	ND	0.06	0.022
naphthalene	7	1	ND	0.05	0.013
phenol	1	0	ND	ND	ND
styrene	1	0	ND	ND	ND
tmb 1,2,4	7	1	ND	0.08	0.013
tmp 2,2,4	5	3	ND	2.19	0.075
toluene	7	0	ND	ND	ND
xlenes	7	4	ND	0.06	0.016
z_ethylene	1	0	ND	ND	ND
z_propane	1	1	0.47	0.47	0.470
z_propylene	4	1	ND	0.14	0.019
zz_butane	1	1	0.75	0.75	0.750

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Alkylation REF_STRM=Butane -----

species name	number data	number quantified	minimum value	maximum value	most likely value
butadiene 1,3	2	1	ND	0.22	0.047
n_hexane	1	1	0.19	0.19	0.190
z_ethane	3	2	ND	1.11	0.105
z_ethylene	1	1	0.03	0.03	0.030
z_propane	3	3	3.13	5.88	3.912
z_propylene	3	3	0.12	2.75	0.569
zz_butane	5	5	2.25	94.24	30.181

-----REF_UNIT=Alkylation REF_STRM=LPG -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	1	0	ND	ND	ND
butadiene 1,3	1	0	ND	ND	ND
cumene	1	0	ND	ND	ND
ethylbenzene	1	0	ND	ND	ND
mtbe	1	0	ND	ND	ND
n_hexane	1	0	ND	ND	ND
tmb 1,2,4	1	0	ND	ND	ND
tmp 2,2,4	1	0	ND	ND	ND
toluene	1	0	ND	ND	ND
xylenes	1	0	ND	ND	ND
z_ethane	2	2	1.32	1.49	1.402
z_ethylene	1	1	0.02	0.02	0.020
z_propane	2	2	83.06	95.66	89.138
z_propylene	2	2	1.18	1.58	1.365
zz_butane	1	1	0.07	0.07	0.070

-----REF_UNIT=Amine Treating REF_STRM=Sour Gas -----

species name	number data	number quantified	minimum value	maximum value	most likely value
hydrogen sulf	1	1	0.86	0.86	0.860
n_hexane	2	2	0.36	0.83	0.547
z_ethane	3	3	4.68	19.30	12.858
z_ethylene	1	0	ND	ND	ND
z_propane	3	3	7.80	41.57	18.639
z_propylene	2	1	ND	0.03	0.017
zz_butane	3	3	0.11	26.61	3.385

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Amine Treating REF_STRM=Treated Olefinic -----

species name	number data	number quantified	minimum value	maximum value	most likely value
butadiene 1,3	2	2	0.18	0.43	0.278
n_hexane	3	3	0.02	0.04	0.027
z_ethane	3	3	0.06	14.64	0.605
z_ethylene	3	1	ND	0.11	0.033
z_propane	3	3	7.55	48.66	14.003
z_propylene	2	2	12.86	31.36	20.082
zz_butane	3	3	5.56	13.91	9.689

-----REF_UNIT=Aromatics Extract REF_STRM=Benzene -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	2	2	99.99	99.99	99.990
cumene	1	0	ND	ND	ND
ethylbenzene	1	0	ND	ND	ND
naphthalene	1	0	ND	ND	ND
tmb 1,2,4	1	0	ND	ND	ND
toluene	1	0	ND	ND	ND
xylenes	1	0	ND	ND	ND

-----REF_UNIT=Aromatics Extract REF_STRM=Heavy Aromatics -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	2	1	ND	5.70	0.239
butadiene 1,3	1	0	ND	ND	ND
cumene	2	2	0.23	1.70	0.625
ethylbenzene	2	2	3.30	3.83	3.555
n_hexane	1	0	ND	ND	ND
naphthalene	2	2	0.03	0.60	0.134
tmb 1,2,4	2	2	4.19	5.70	4.887
tmb 2,2,4	1	0	ND	ND	ND
toluene	2	2	18.72	20.00	19.349
xylenes	2	2	19.27	30.79	24.358
z_propylene	1	0	ND	ND	ND

-----REF_UNIT=Aromatics Extract REF_STRM=Toluene -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	2	1	ND	0.59	0.077
cumene	2	0	ND	ND	ND
ethylbenzene	2	2	0.16	5.48	0.936
naphthalene	1	0	ND	ND	ND
tmb 1,2,4	2	1	ND	0.30	0.055
toluene	4	4	83.25	100.00	95.326
xylenes	2	2	0.06	6.93	0.645

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Aromatics Extract REF_STRM=Xylenes -----

species name	number data	number quantified	minimum value	maximum value	most likely value
cumene	1	1	0.59	0.59	0.590
ethylbenzene	1	1	16.08	16.08	16.080
toluene	1	1	0.19	0.19	0.19
xylenes	1	1	77.89	77.89	77.890

-----REF_UNIT=Asphalt Plant REF_STRM=Used Solvent -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	1	1	0.15	0.15	0.150
cumene	1	0	ND	ND	ND
ethylbenzene	6	6	0.10	1.39	0.295
n_hexane	2	1	0.10	0.35	0.187
toluene	3	3	0.11	0.78	0.257
xylenes	6	6	0.18	2.40	0.504

-----REF_UNIT=Atm. Distillation REF_STRM=Atm. Resid. -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	1	0	ND	ND	ND
biphenyl	2	2	0.04	0.04	0.040
cumene	1	0	ND	ND	ND
ethylbenzene	1	1	0.08	0.08	0.080
naphthalene	2	2	2.00	2.00	2.000
toluene	1	0	ND	ND	ND
xylenes	2	2	0.05	0.05	0.050

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Atm. Distillation REF_STRM=Heavy Atm. Gas Oil -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	5	0	ND	ND	ND
biphenyl	2	2	0.06	0.10	0.077
butadiene 1,3	4	0	ND	0.02	ND
cresols	3	1	ND	0.10	0.032
cumene	4	1	ND	0.16	0.020
ethylbenzene	5	0	ND	ND	ND
mek	1	0	ND	ND	ND
methanol	1	0	ND	ND	ND
mtbe	2	0	ND	ND	ND
n_hexane	3	0	ND	ND	ND
naphthalene	4	3	ND	0.06	0.032
phenol	2	1	ND	0.02	0.014
styrene	1	0	ND	ND	ND
tmb 1,2,4	3	2	ND	0.06	0.024
tmp 2,2,4	3	0	ND	ND	ND
toluene	6	2	ND	0.10	ND
xylene	6	5	ND	0.70	0.093
z_ethylene	2	0	ND	ND	ND
z_propane	2	0	ND	ND	ND
z_propylene	3	0	ND	ND	ND
zz_butane	2	0	ND	ND	ND

-----REF_UNIT=Atm. Distillation REF_STRM=Heavy Naphtha -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	18	18	0.08	2.07	0.716
biphenyl	1	1	0.15	0.15	0.150
cumene	13	13	0.02	0.91	0.191
ethylbenzene	18	18	0.50	3.98	1.095
hydrogen sulf	2	0	ND	ND	ND
n_hexane	15	15	0.28	7.53	3.089
naphthalene	7	5	ND	1.27	0.065
tmb 1,2,4	13	13	0.10	3.00	0.749
tmp 2,2,4	1	1	0.03	0.03	0.030
toluene	18	18	0.87	5.87	3.575
xylene	18	18	1.88	7.00	4.662
z_propane	2	2	0.10	0.54	0.232
zz_butane	7	7	0.09	0.78	0.186

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Atm. Distillation REF_STRM=Light Atm. Gas Oil -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	8	4	ND	0.03	0.011
biphenyl	2	2	0.04	0.08	0.057
butadiene 1,3	4	0	ND	0.10	ND
cresols	3	0	ND	0.02	ND
cumene	9	2	ND	0.10	ND
ethylbenzene	10	7	ND	0.10	0.023
mek	2	0	ND	ND	ND
methanol	2	0	ND	ND	ND
mtbe	2	0	ND	ND	ND
n_hexane	5	3	ND	0.09	0.025
naphthalene	10	8	ND	0.69	0.089
phenol	3	0	ND	0.02	ND
styrene	2	0	ND	ND	ND
tmb 1,2,4	7	7	0.07	0.70	0.292
tmp 2,2,4	4	2	ND	0.07	ND
toluene	11	9	ND	0.16	0.030
xylene	10	10	0.06	0.80	0.206
z_ethylene	2	0	ND	ND	ND
z_propane	2	0	ND	ND	ND
z_propylene	4	0	ND	ND	ND
zz_butane	2	0	ND	ND	ND

-----REF_UNIT=Atm. Distillation REF_STRM=Light Ends -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	12	11	ND	0.93	0.204
biphenyl	5	1	ND	0.12	0.016
butadiene 1,3	5	1	ND	0.15	0.017
cresols	4	0	ND	ND	ND
cumene	6	0	ND	ND	ND
ethylbenzene	9	3	ND	0.03	ND
mek	4	0	ND	ND	ND
methanol	1	0	ND	ND	ND
mtbe	4	0	ND	ND	ND
n_hexane	14	14	0.70	7.17	2.445
naphthalene	5	1	ND	0.03	0.012
phenol	4	0	ND	ND	ND
styrene	5	0	ND	ND	ND
tmb 1,2,4	6	2	ND	0.08	ND
tmp 2,2,4	5	0	ND	ND	ND
toluene	9	9	0.02	0.24	0.093
xylene	9	4	ND	0.10	ND
z_ethane	4	4	1.33	15.13	5.716
z_ethylene	4	4	0.20	7.32	1.800
z_propane	5	5	0.14	31.00	10.461
z_propylene	10	7	ND	7.40	0.051
zz_butane	5	5	0.05	20.12	8.530

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Atm. Distillation REF_STRM=SR Gasoline -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	2	2	0.59	2.00	1.086
ethylbenzene	1	1	1.00	1.00	1.000
n_hexane	2	2	2.32	9.00	4.569
naphthalene	1	1	0.10	0.10	0.100
toluene	1	1	1.10	1.10	1.100
xylene	1	1	1.00	1.00	1.000

-----REF_UNIT=Atm. Distillation REF_STRM=SR Kerosene -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	13	6	ND	0.05	ND
biphenyl	6	4	ND	0.24	0.034
butadiene 1,3	6	0	ND	ND	ND
cresols	3	0	ND	ND	ND
cumene	13	10	ND	0.30	0.031
ethylbenzene	13	12	ND	0.55	0.100
hydrogen sulf	1	0	ND	ND	ND
mek	3	0	ND	ND	ND
methanol	2	0	ND	ND	ND
mtbe	3	0	ND	ND	ND
n_hexane	10	8	ND	0.14	0.034
naphthalene	20	18	ND	1.25	0.100
phenol	3	0	ND	ND	ND
styrene	3	0	ND	ND	ND
tmb 1,2,4	14	14	0.07	1.74	0.339
tmb 2,2,4	6	2	ND	0.07	ND
toluene	16	15	ND	0.40	0.093
xylene	15	15	0.07	1.33	0.292
z_ethylene	3	0	ND	ND	ND
z_propane	3	0	ND	ND	ND
z_propylene	7	0	ND	ND	ND
zz_butane	3	1	ND	0.08	0.028

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Atm. Distillation REF_STRM=SR Naphtha -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	38	38	0.10	4.76	1.197
biphenyl	3	0	ND	ND	ND
butadiene 1,3	5	0	ND	ND	ND
cresols	2	0	ND	ND	ND
cumene	20	14	ND	0.62	0.059
ethylbenzene	28	26	ND	2.47	0.313
hydrogen sulf	2	1	ND	0.02	0.014
mek	2	0	ND	ND	ND
methanol	4	0	ND	ND	ND
mtbe	2	0	ND	ND	ND
n_hexane	30	30	1.20	13.91	5.981
naphthalene	15	6	ND	0.50	0.012
phenol	2	0	ND	ND	ND
styrene	2	0	ND	ND	ND
tmb 1,2,4	14	10	ND	4.70	0.119
tmp 2,2,4	7	1	ND	0.80	0.019
toluene	35	34	ND	7.00	1.810
xylene	27	27	0.14	6.20	1.707
z_ethane	1	1	0.82	0.82	0.820
z_ethylene	4	0	ND	ND	ND
z_propane	8	6	ND	13.03	0.197
z_propylene	7	1	ND	0.09	0.014
zz_butane	15	15	0.16	27.90	2.222

-----REF_UNIT=Cat. Hydrocracker REF_STRM=Heavy H/C Distillate -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	2	1	ND	0.21	0.046
butadiene 1,3	1	0	ND	ND	ND
cumene	1	0	ND	ND	ND
ethylbenzene	1	0	ND	ND	ND
n_hexane	1	0	ND	ND	ND
naphthalene	2	1	ND	0.22	0.047
tmb 1,2,4	2	1	ND	0.36	0.060
tmp 2,2,4	1	0	ND	ND	ND
toluene	1	0	ND	ND	ND
xylene	2	1	ND	0.22	0.047
z_ethylene	1	0	ND	ND	ND
z_propane	1	0	ND	ND	ND
z_propylene	1	0	ND	ND	ND
zz_butane	1	0	ND	ND	ND

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Cat. Hydrocracker REF_STRM=Heavy H/C Naphtha -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	5	5	0.03	4.20	0.630
cresols	1	0	ND	ND	ND
ethylbenzene	4	4	0.64	3.58	1.579
n_hexane	3	2	ND	2.10	0.145
naphthalene	3	3	0.04	0.29	0.121
tmb 1,2,4	3	3	0.89	5.60	2.828
toluene	5	5	0.96	5.79	3.102
xylenes	3	3	2.99	6.25	4.155

-----REF_UNIT=Cat. Hydrocracker REF_STRM=Light H/C Distillate -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	3	2	ND	0.67	0.082
butadiene 1,3	2	0	ND	ND	ND
cresols	1	0	ND	ND	ND
cumene	2	0	ND	ND	ND
ethylbenzene	3	3	0.08	1.25	0.424
methanol	1	0	ND	ND	ND
mtbe	2	1	ND	0.03	0.017
n_hexane	2	1	ND	0.04	0.020
naphthalene	2	2	0.30	1.86	0.747
tmb 1,2,4	3	2	ND	3.50	0.187
tmb 2,2,4	2	1	ND	0.05	0.022
toluene	3	3	0.72	2.50	1.557
xylenes	3	3	1.87	2.65	2.316
z_ethylene	1	0	ND	ND	ND
z_propane	1	0	ND	ND	ND
z_propylene	2	0	ND	ND	ND
zz_butane	1	0	ND	ND	ND

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Cat. Hydrocracker REF_STRM=Light H/C Naphtha -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	6	6	1.70	6.30	3.348
butadiene 1,3	1	0	ND	ND	ND
cumene	3	0	ND	ND	ND
ethylbenzene	3	3	1.10	2.10	1.624
methanol	1	0	ND	ND	ND
n_hexane	3	3	1.20	2.26	1.551
naphthalene	4	0	ND	ND	ND
tmb 1,2,4	1	0	ND	ND	ND
tmp 2,2,4	1	1	4.99	4.99	4.990
toluene	4	4	2.10	19.17	5.457
xylene	2	2	6.72	12.81	9.278
z_ethylene	1	0	ND	ND	ND
z_propane	1	0	ND	ND	ND
z_propylene	1	0	ND	ND	ND
zz_butane	1	0	ND	ND	ND

-----REF_UNIT=Cat. Hydrocracker REF_STRM=Sat. Gas -----

species name	number data	number quantified	minimum value	maximum value	most likely value
hydrogen sulf	1	1	5.60	5.60	5.600
z_ethane	1	1	13.38	13.38	13.380
z_propane	1	1	71.91	71.91	71.910
z_propylene	1	1	0.12	0.12	0.120
zz_butane	1	1	0.17	0.17	0.170

-----REF_UNIT=Cat. Hydrotreater REF_STRM=Cat. Cracker Feed -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	3	0	ND	ND	ND
butadiene 1,3	2	0	ND	ND	ND
cresols	1	0	ND	ND	ND
cumene	3	0	ND	ND	ND
ethylbenzene	3	0	ND	ND	ND
methanol	2	0	ND	ND	ND
n_hexane	3	0	ND	ND	ND
naphthalene	3	1	ND	0.15	0.039
tmb 1,2,4	1	0	ND	ND	ND
tmp 2,2,4	2	0	ND	ND	ND
toluene	3	0	ND	ND	ND
xylene	3	1	ND	0.05	0.022
z_ethane	1	0	ND	ND	ND
z_ethylene	3	0	ND	ND	ND
z_propane	3	0	ND	ND	ND
z_propylene	3	0	ND	ND	ND
zz_butane	3	0	ND	ND	ND

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Cat. Isomer'zn REF_STRM=Isobutane -----

species name	number data	number quantified	minimum value	maximum value	most likely value
z_ethane	3	3	0.08	0.67	0.231
z_propane	3	3	0.56	8.36	2.055
zz_butane	3	3	14.77	53.13	30.216

-----REF_UNIT=Cat. Isomer'zn REF_STRM=Isom Naphtha -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	2	1	ND	0.51	0.071
butadiene 1,3	1	0	ND	ND	ND
cumene	1	0	ND	ND	ND
n_hexane	5	5	0.95	5.42	2.588
naphthalene	1	0	ND	ND	ND
tmb 1,2,4	1	0	ND	ND	ND
tmb 2,2,4	1	0	ND	ND	ND
toluene	2	1	ND	0.64	0.080
xylenes	2	2	0.02	0.28	0.075
z_propylene	1	0	ND	ND	ND
zz_butane	4	4	0.63	1.43	0.900

-----REF_UNIT=Cat. Reformer REF_STRM=Reformate -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	37	37	0.11	20.00	4.647
biphenyl	2	0	ND	ND	ND
butadiene 1,3	8	0	ND	0.10	ND
cumene	29	27	ND	1.25	0.231
ethylbenzene	36	36	0.07	8.60	3.305
methanol	7	0	ND	ND	ND
n_hexane	30	30	0.05	5.90	2.183
naphthalene	28	24	ND	4.70	0.302
styrene	2	2	0.09	0.13	0.108
tmb 1,2,4	25	24	ND	14.20	3.754
tmb 2,2,4	13	5	ND	1.38	ND
toluene	38	38	5.06	32.24	15.978
xylenes	37	37	2.36	34.43	16.326
z_ethane	1	0	ND	ND	ND
z_ethylene	8	0	ND	ND	ND
z_propane	12	4	ND	1.52	ND
z_propylene	10	0	ND	ND	ND
zz_butane	20	13	ND	10.72	0.089

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Cat. Reformer REF_STRM=Reformate Gas -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	2	2	0.55	0.68	0.612
butadiene 1,3	2	1	ND	0.02	0.014
n_hexane	4	4	0.02	1.77	0.386
z_ethane	4	4	6.57	18.05	11.964
z_ethylene	2	0	ND	ND	ND
z_propane	4	4	22.71	39.60	29.022
z_propylene	5	4	ND	0.13	0.044
zz_butane	4	4	9.68	29.76	15.385

-----REF_UNIT=Coker REF_STRM=Coker Gas Oil -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	7	1	ND	0.10	0.014
butadiene 1,3	6	1	ND	0.10	0.015
cresols	1	0	ND	ND	ND
cumene	2	0	ND	ND	ND
ethylbenzene	4	1	ND	0.70	0.029
methanol	1	0	ND	ND	ND
n_hexane	2	0	ND	ND	ND
naphthalene	5	3	ND	3.00	0.021
tmb 1,2,4	2	1	ND	0.03	0.017
tmp 2,2,4	2	0	ND	ND	ND
toluene	7	4	ND	0.11	0.013
xylenes	7	5	ND	1.20	0.050
z_ethylene	2	0	ND	ND	ND
z_propane	2	0	ND	ND	ND
z_propylene	2	0	ND	ND	ND
zz_butane	2	0	ND	ND	ND

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Coker REF_STRM=Coker Heavy Naphtha -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	10	10	0.10	1.70	0.291
biphenyl	1	0	ND	ND	ND
butadiene 1,3	6	1	ND	0.10	0.015
cresols	2	1	ND	0.03	0.017
cumene	7	7	0.04	0.40	0.149
ethylbenzene	11	11	0.51	2.50	0.927
mek	1	0	ND	ND	ND
mtbe	1	0	ND	ND	ND
n_hexane	10	7	ND	4.35	0.178
naphthalene	5	0	ND	ND	ND
phenol	1	0	ND	ND	ND
styrene	2	2	0.03	0.04	0.035
tmb 1,2,4	10	10	0.57	2.70	0.926
tmp 2,2,4	6	4	ND	1.75	0.025
toluene	12	12	1.39	4.74	2.254
xylene	11	10	1.98	4.70	3.218
z_propane	2	2	0.09	0.26	0.153
z_propylene	5	2	ND	0.12	ND
zz_butane	2	2	0.53	0.85	0.671

-----REF_UNIT=Coker REF_STRM=Coker Light Naphtha -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	6	6	0.41	0.92	0.679
butadiene 1,3	5	1	ND	0.10	0.016
cumene	4	3	ND	0.15	0.043
ethylbenzene	6	3	ND	1.00	ND
hydrogen sulf	1	1	0.09	0.09	0.090
mek	1	1	0.29	0.29	0.290
methanol	1	0	ND	ND	ND
n_hexane	3	2	ND	2.56	0.160
naphthalene	6	1	ND	0.22	0.017
styrene	1	1	0.51	0.51	0.510
tmb 1,2,4	5	5	0.03	0.60	0.137
tmp 2,2,4	3	2	ND	0.82	0.091
toluene	6	6	0.02	1.11	0.206
xylene	5	4	0.03	1.00	0.066
z_ethylene	2	0	ND	ND	ND
z_propane	2	2	0.28	1.88	0.726
z_propylene	3	0	ND	ND	ND
zz_butane	3	3	0.36	3.26	0.906

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Coker REF_STRM=Unsat. Gas -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	1	1	0.60	0.60	0.600
butadiene 1,3	4	4	0.03	0.11	0.056
ethylbenzene	1	1	0.02	0.02	0.020
hydrogen sulf	1	1	7.12	7.12	7.120
n_hexane	4	4	1.23	6.77	2.795
toluene	1	1	0.22	0.22	0.220
xylenes	1	1	0.03	0.03	0.030
z_ethane	3	3	9.96	16.76	13.846
z_ethylene	4	4	1.04	1.58	1.405
z_propane	3	3	9.18	14.93	11.921
z_propylene	4	4	3.70	5.28	4.627
zz_butane	3	3	6.68	8.56	7.334

-----REF_UNIT=Cracked Gas Plant REF_STRM=Fuel Gas -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	1	0	ND	ND	ND
butadiene 1,3	5	3	ND	0.36	0.043
cumene	1	0	ND	ND	ND
ethylbenzene	2	0	ND	ND	ND
hydrogen sulf	3	1	ND	21.71	0.466
n_hexane	3	2	ND	0.88	0.094
naphthalene	1	0	ND	ND	ND
tmb 1,2,4	1	0	ND	ND	ND
tmp 2,2,4	2	1	ND	0.03	0.017
toluene	2	0	ND	ND	ND
xylenes	2	1	ND	0.07	0.026
z_ethane	4	4	10.67	26.59	20.244
z_ethylene	5	5	2.70	20.20	11.158
z_propane	4	4	0.51	8.91	2.283
z_propylene	6	6	2.36	7.20	4.600
zz_butane	4	4	0.03	0.85	0.147

-----REF_UNIT=Cracked Gas Plant REF_STRM=Olefins -----

species name	number data	number quantified	minimum value	maximum value	most likely value
butadiene 1,3	5	4	ND	11.27	0.279
hydrogen sulf	3	0	ND	ND	ND
n_hexane	4	4	0.02	0.40	0.097
z_ethane	1	1	0.30	0.30	0.300
z_propane	4	4	1.94	27.24	4.921
z_propylene	2	2	5.15	10.10	7.212
zz_butane	4	4	7.87	44.38	26.036

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Cracked Gas Plant REF_STRM=Sour Gas -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	1	1	0.03	0.03	0.030
butadiene 1,3	3	3	0.03	0.61	0.171
hydrogen sulf	3	1	ND	7.13	0.267
n_hexane	2	2	0.22	2.76	0.779
toluene	1	1	0.03	0.03	0.030
z_ethane	2	2	8.95	18.32	12.805
z_ethylene	2	2	0.38	5.36	1.427
z_propane	2	2	15.95	21.11	18.350
z_propylene	2	2	1.77	9.31	4.059
zz_butane	2	2	5.47	7.16	6.258

-----REF_UNIT=Cracked Gas Plant REF_STRM=Unsat. Gas -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	1	1	3.50	3.50	3.500
butadiene 1,3	4	2	ND	1.10	ND
ethylbenzene	1	1	2.20	2.20	2.200
n_hexane	3	3	0.04	0.28	0.191
toluene	1	1	3.20	3.20	3.200
z_ethane	3	3	5.79	25.93	7.204
z_ethylene	3	3	5.83	24.75	7.259
z_propane	3	3	0.70	8.08	6.058
z_propylene	3	3	2.46	23.89	16.622
zz_butane	3	3	0.27	3.54	2.468

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Distillate Blending REF_STRM=Diesel Fuel -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	8	0	ND	ND	ND
biphenyl	4	4	0.03	0.26	0.071
butadiene 1,3	4	0	ND	ND	ND
cresols	2	2	0.05	0.05	0.050
cumene	7	5	ND	0.17	0.024
ethylbenzene	9	7	ND	0.18	0.029
methanol	1	0	ND	ND	ND
mtbe	3	1	ND	0.06	0.024
n_hexane	5	3	ND	0.07	0.016
naphthalene	11	10	ND	0.54	0.170
phenol	1	1	0.26	0.26	0.260
tmb 1,2,4	9	9	0.12	1.12	0.225
tmp 2,2,4	4	1	ND	0.02	0.012
toluene	10	9	ND	0.29	0.050
xylenes	13	11	ND	1.10	0.122
z_ethane	2	0	ND	ND	ND
z_ethylene	4	0	ND	ND	ND
z_propane	4	0	ND	ND	ND
z_propylene	5	0	ND	ND	ND
zz_butane	4	0	ND	ND	ND

-----REF_UNIT=Distillate Blending REF_STRM=Home Heating Oil -----

species name	number data	number quantified	minimum value	maximum value	most likely value
biphenyl	4	4	0.10	0.25	0.166
ethylbenzene	1	1	0.10	0.10	0.100
naphthalene	6	6	0.13	0.75	0.364
tmb 1,2,4	6	6	0.13	0.92	0.325
toluene	4	4	0.08	0.15	0.097
xylenes	6	6	0.10	0.56	0.243

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Fluid Cat. Cracker REF_STRM=Cracked gasoline -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	33	33	0.08	3.20	0.751
butadiene 1,3	5	0	ND	0.10	ND
cumene	11	9	ND	0.49	0.037
ethylbenzene	26	25	ND	1.89	0.754
mek	1	0	ND	ND	ND
methanol	2	0	ND	ND	ND
mtbe	1	0	ND	ND	ND
n_hexane	24	24	0.24	5.20	0.812
naphthalene	21	16	ND	1.80	0.096
phenol	2	1	ND	2.20	0.148
styrene	1	0	ND	ND	ND
tmb 1,2,4	19	18	ND	7.30	0.762
tmp 2,2,4	9	7	ND	1.19	0.034
toluene	31	30	0.69	9.34	3.336
xylene	29	27	0.44	18.10	4.574
z_ethane	1	0	ND	ND	ND
z_ethylene	3	0	ND	ND	ND
z_propane	6	3	ND	0.26	0.023
z_propylene	8	4	ND	0.57	0.019
zz_butane	6	6	0.08	1.29	0.407

-----REF_UNIT=Fluid Cat. Cracker REF_STRM=DCO -----

species name	number data	number quantified	minimum value	maximum value	most likely value
tmb 1,2,4	1	1	0.16	0.16	0.160
xylene	1	1	0.09	0.09	0.090

-----REF_UNIT=Fluid Cat. Cracker REF_STRM=Heavy Cat. Gas Oil -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	8	6	ND	1.26	0.175
butadiene 1,3	3	0	ND	ND	ND
cumene	6	6	0.03	0.29	0.114
ethylbenzene	8	8	0.33	4.18	1.128
methanol	1	0	ND	ND	ND
n_hexane	4	2	ND	0.55	ND
naphthalene	9	9	0.16	6.50	0.995
tmb 1,2,4	7	7	2.35	11.60	4.735
tmp 2,2,4	4	2	ND	1.00	ND
toluene	8	8	0.64	8.94	1.671
xylene	8	8	2.43	13.66	6.998
z_ethylene	2	0	ND	ND	ND
z_propane	2	0	ND	ND	ND
z_propylene	3	0	ND	ND	ND
zz_butane	2	2	0.05	0.87	0.209

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Fluid Cat. Cracker REF_STRM=Light Cat. Gas Oil -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	12	10	ND	1.56	0.656
biphenyl	5	5	0.08	0.99	0.355
butadiene 1,3	4	0	ND	ND	ND
cresols	1	0	ND	ND	ND
cumene	11	6	ND	0.62	0.013
ethylbenzene	16	16	0.09	2.30	0.557
methanol	6	0	ND	ND	ND
n_hexane	8	5	ND	1.84	0.118
naphthalene	15	14	ND	4.10	0.479
phenol	1	0	ND	ND	ND
styrene	1	1	0.27	0.27	0.270
tmb 1,2,4	16	16	0.23	7.30	1.068
tmb 2,2,4	7	3	ND	1.13	ND
toluene	20	20	0.08	6.00	1.070
xylene	18	18	0.21	9.54	1.943
z_ethane	1	0	ND	ND	ND
z_ethylene	6	0	ND	ND	ND
z_propane	6	1	ND	0.02	0.011
z_propylene	7	0	ND	ND	ND
zz_butane	6	2	ND	0.12	ND

-----REF_UNIT=Gasoline Blending REF_STRM=Aviation Gasoline -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	4	4	0.51	1.62	0.847
cresols	2	2	0.05	0.16	0.089
cumene	3	3	0.02	0.23	0.064
ethylbenzene	4	4	0.25	3.70	0.561
n_hexane	3	3	0.12	5.67	0.892
naphthalene	4	4	0.05	2.30	0.209
tmb 1,2,4	1	1	0.50	0.50	0.500
toluene	4	4	3.62	10.39	7.049
xylene	4	4	1.50	8.20	2.349

Statistical Summary Listed By Refinery Unit And Stream

-----REF_UNIT=Gasoline Blending REF_STRM=Conventional Gasoline -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	43	43	0.04	7.15	1.292
butadiene 1,3	6	0	ND	ND	ND
cresols	1	0	ND	ND	ND
cumene	30	28	ND	0.95	0.150
ethylbenzene	36	35	ND	3.75	0.926
methanol	3	1	ND	2.04	0.143
mtbe	21	19	ND	13.00	0.879
n_hexane	29	28	ND	7.22	1.338
naphthalene	26	25	ND	1.06	0.303
phenol	1	0	ND	ND	ND
styrene	3	3	0.07	0.09	0.078
tmb 1,2,4	24	24	0.03	7.40	2.119
tmp 2,2,4	20	20	0.09	11.90	1.965
toluene	42	39	ND	17.00	5.248
xylene	36	36	0.13	19.11	4.911
z_ethane	2	0	ND	ND	ND
z_ethylene	6	0	ND	ND	ND
z_propane	8	5	ND	0.11	0.029
z_propylene	7	0	ND	ND	ND
zz_butane	11	11	0.58	5.35	2.932

-----REF_UNIT=Gasoline Blending REF_STRM=Reformulated Gasoline -----

species name	number data	number quantified	minimum value	maximum value	most likely value
benzene	8	8	0.74	1.73	1.048
butadiene 1,3	5	0	ND	ND	ND
cresols	1	0	ND	ND	ND
cumene	6	6	0.03	0.65	0.101
ethylbenzene	6	6	0.66	1.80	1.213
mtbe	3	3	6.10	15.81	9.409
n_hexane	5	5	0.81	1.80	1.239
naphthalene	7	5	ND	0.45	0.039
phenol	1	0	ND	ND	ND
tmb 1,2,4	5	5	1.67	3.11	2.438
tmp 2,2,4	5	5	0.05	3.80	0.425
toluene	7	7	2.07	14.00	5.955
xylene	6	6	3.33	11.00	7.042
z_propylene	4	0	ND	ND	ND