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Comparison of Hydrogenation and Cracking Gasolines from Petroleum Middle Oils

By Reitz, Donath, et al, Ludwigshafen, 23 April 1942
(With 2 Sketches)

Synopsis.

The following hydrogenation gasolines were produced from petroleum middle oils (Bruchsal and Rumanian) in 1 liter converters:

1) 200 atm 6434 - gasoline, end point 135° C.

2) The same with end point 185° C, decomposed into 50% light gasoline and 50% heavy gasoline, producing a mixed gasoline with end point 165° C (after redistillation) and about 30% aromatics by dehydrogenation of the latter with K-7360 at 25 atm.

The samples were thoroughly investigated (residual gasoline, octane number of 20° fractions, overload curve) and compared with the following catalytic cracking gasolines made by Dr. Free in a 50 liter converter:

3) 6752-cracking gasolines, end point 155° C.

4) The same catalytically refined, i.e. olefins hydrogenated, in 1 liter converter @ 20 atm over K-7360.

The following table shows the most important results:

Gasoline Sample	End-point	%-100°C	%/wt. Aromat.	vapor-press.	O.N. (M.M) & +0.12 % Pb	Resid.Gas. O.N.	Quality
6434 Gasoline from Bruchsal Oil	135	57	7	0.41	68/89	66.5/88.5	barely B_4
6434 Gasoline from Rumanian Oil	135	63	6	0.47	69.5/91	70/89.5	like B_4
Dehydr. 6434 Gasol. fr. Bruchsal Oil	165	68	35	0.55	79/94	72/100	slightly above C_1
Dehydr. 6434 Gasol. fr. Rumanian Oil	165	47	32	0.34	73/93	68/90	barely C_1
Crack. Gasol. fr. Bruchsal Oil	155	56	20	0.47	76/93.5	69.5/91	like B_4
Ditto, unsaturated hydrogenated	155	61	17	0.45	76/94	72/92	slightly above B_4
Crack. Gasol. fr. Rumanian Oil	155	54	25	0.40	74.5/--	70.5/91	average between C_1 & B_4
Ditto, unsaturated hydrogenated	155	53	20	?	72/92.5	69/86	

Decomposition of Fractions.

The differences between the various gasoline samples in the octane number of the fractions were essentially due to the difference in aromatics content and are, therefore, appreciable only above 100° C. The cracked gasolines are between the 6434-gasolines and the dehydrogenated gasolines. Below 100° C the cracked gasolines appear to be 2-3 points better than the hydrogenation gasolines.

Residual Gasolines.

The cracked gasolines are somewhat superior to hydrogenation gasolines in the octane numbers of the residual gasoline fractions, apparently more so in the upper than in the lower fractions.

Overload Behavior.

In the examination of the above table the various percentage contents to 100° C or the various vapor pressures of the individual gasoline samples must be taken into consideration. After converting the data to equal vapor pressure (0.45 atm) by the addition of light end constituents, which were not added to the gasolines in their production, or by the removal of a part of the pentane, the following condition prevails:

B-quality will be obtained from Rumanian middle oil by benzination, a quality between B_4 and C_1 by cracking, and C_1 quality by benzination in combination with dehydrogenation of the upper 50% fraction. The respective gasolines from Buchsal middle oil are somewhat poorer in quality. The influence of the hydrogenation of olefins on the quality of cracked gasolines is not quite clear with the various feed oils and unimportant in any case.

Comparison of Yields.

The following approximate figures may be expected:

Feed Oil	Bruchsal Middle Oil			Rumanian Middle Oil		
From 100 kg split Mi-Oil are obtained:	Gasoline kg	Butane kg	(of which Iso)	Gasoline kg	Butane kg	(of which Iso)
Benzination	81	15	(10.5)	86	11.5	(8)
Benzin. + DHD	77	12	(7)	83	9	(5)
Catalyt. Cracking	64	20	(17)	69	11	(9.5)

The evaluation of the cracked gasolines in comparison with the hydrogenated gasolines is essentially the same as with former similar comparative experiments based on bituminous coal prehydrogenation middle oil.

The Experiments.

This report deals with experiments for quality comparisons between catalytic cracking gasolines and hydrogenation gasolines from the same feed material. These experiments were made in continuation of comparison experiments with bituminous coal prehydrogenation middle oil and petroleum middle oils, compare report 19906 of 28 January 1942. Two middle oils were taken one H_2-rich (Bruchsal) and one H_2-poor (comparatively) from Rumanian oil, compare

Table 1. The cracked gasolines were made by Dr. Free in a 50 liter converter over synthetic aluminum silicate. Besides the standard cracked gasoline, a sample was made, in every case, in which the unsaturated were catalytically hydrogenated @ 25 atm and 16 mV with catalyst 7360. The following two samples of hydrogenation gasolines were made from each feed oil in 1 liter converters:

1. - 6434 gasoline with an end point of about 135° C, obtained by recycling the B-middle oil.

2. - Dehydrogenation gasoline with an end point of 165° C, obtained from 6434 gasoline with an end point of 170 by decomposition into 2 quantitatively equal fractions, dehydrogenating the heavier fraction over K-7360, mixing the DHD obtained with the light fraction and redistilling to 165° C end point. The cracked gasolines had an end point of 155° C. The various end points were selected in order to obtain an optimum in each operating method, i.e. greatest possible yield without too great a deterioration of quality by too high boiling constituents.

Table 1. Feed Oils

	Bruchsal Middle Oil		Rumanian Middle Oil	
	P-1203 200 to 325° C 15/9/41	P-1203 180-330° C 3/11/41	P-1490 170-350° C 28/11/41	P-1490 180-350° C 5/1/42
Spec.Grav./20° C	0.811	0.812	0.829	0.835
A.P. °C	+67.5	+71.8	+62.5	+63.5
ASTM:				
Initial Boil °C	162	188	170	180
%-180	10.5	--	1.5	--
%-200	20.5	6	12.5	6
%-225	35	22.5	30	19
%-250	51	43	44	40
%-275	68.5	63	59	56
%-300	89	84	72	74
%-325	--	96	83.5	86
%-350	--	--	93	93
End Point °C	328	330	357	357
%	99	98.5	97.5	98
Remarks	run in October	run in December and at the crack. exp.	used for hydr.exp.	used for the crack. exp.

Product Comparisons.

The product comparisons were made principally in 3 directions: comparison of overload behavior, comparison of octane numbers of 25° C fractions, and comparison of residual gasolines.

1. Decomposition of Fractions. (See Table 5 and Fig. 1)

The fractions of cracked gasoline from Rumanian oil were not decomposed. The octane numbers of the fractions are largely dependent upon their aromatics content. Appreciable differences between the individual fractions are, therefore, obtained only in the range above 100°, in which the aromatic contents show greater differences. Below 100° the cracked gasolines appear to have a basic octane number about 2 points higher than the hydrogenation gasolines while the lead values are practically the same for all samples. Above 100° the aromatics content, as well as the basic octane number of the cracked gasolines, are between the 6434 gasolines and the 6434 gasolines dehydrogenated to about 30% aromatics. The lead values of the cracked gasolines are more like those of the 6434 gasolines not dehydrogenated and are only slightly above them. In general, the results are the same as those of the corresponding comparative experiments based on bituminous coal prehydrogenation middle oil.

The original and the hydrogenated cracked gasoline samples do not differ very clearly in their octane numbers. The big differences in the aromatics distribution may not be real and are possibly due to varyingly sharp distillation in the decomposition of the fractions.

The corresponding gasolines from Bruchsal and Rumanian oil differ only very little from each other. In the 6434 gasolines it is noticeable that at 80° the gasoline from Rumanian oil is distinctly inferior to that from Bruchsal oil, while at 90° and 110° both gasolines are alike. With the dehydrogenated gasolines, the differences in octane numbers are due to the somewhat varying aromatics distribution.

2. Residual Gasolines. (See Table 4 and Fig. 2)

Besides the overall residual gasolines, fractions to and above 100°C were investigated. With the overall gasolines (Gesamtbenzinen) the differences between the individual samples are primarily dependent upon the differences in the residual gasoline boiling curves. Thus, in the products from Bruchsal oil the residual gasoline octane numbers run clearly parallel to the %-70 or -100°C, which vary greatly with these products, while in the products from Rumanian oil, which show very similar residual gasoline boiling curves among themselves, the residual gasoline octane numbers also equal each other within 2.5 points.

In detail it was found that in the cracked gasoline from Bruchsal oil, the basic octane number rises with the hydrogenation of olefins, while it drops in the cracked gasolines from Rumanian oil. In the latter case a similar, but even greater change in the lead value could be observed. Based on an equal boiling curve, no clear advantage of the cracked gasolines over hydrogenation gasolines can, therefore, be found from the overall residual gasoline octane numbers, but see below.

When Rumanian oil is used as feed material, the basic residual gasoline octane numbers are about 2 points better than with Bruchsal oil, while the differences in the lead values due to the paraffinic character of the products from Bruchsal oil disappear.

The octane numbers of the residual gasoline fractions to and above 100°C are too incomplete and are, therefore, not discussed here. Furthermore, in the fractions to 100°C the boiling curves, without which an evaluation is hardly possible, are missing. The superiority of the cracked gasoline in the residual gasoline to 100° C, where it isn't based on boiling curve differences, would be limited to the slight advantage in the octane number of the overall gasoline fractions determined above.

Finally, the residual gasoline octane numbers of the fractions were calculated from their octane numbers in the same way as in previous comparative experiments. This shows a superiority of the cracked gasolines from Bruchsal oil, equal to about 2 points in the lowest fractions and increasing rapidly in the higher fractions. Apparently, the cracked gasoline not hydrogenated is even better than the hydrogenated. It should be pointed out that the corresponding experiments based on bituminous coal showed a smaller difference between cracked and hydrogenation gasolines in the upper fractions. As expected, the residual gasoline octane number of the dehydrogenated fractions becomes still worse by dehydrogenation of the 6434 gasolines.

3. Aromatics Composition.

The percentage composition of aromatics extracted from the cracked gasolines and the dehydrogenated 6434 gasolines is very similar, see Table 4. The toluol fractions are between 24 and 31% and the xylol fractions between 54 and 40%.

4. Overload Behavior. (See Table 3 and table in synopsis)

In comparing the overload behavior of the various gasoline samples the differences in their boiling curves must be considered, which was not necessary in the foregoing comparisons. The gasolines were freed of butane, but the light end constituents obtained in their production were not altogether added to them. If all the gasolines were to have been compared at equal vapor pressure, about 0.45 atm, light ends could have been added to them in some cases, and only from the dehydrogenated 6434 gasolines from Bruchsal middle oil would some pentane have had to be stabilized out. In this case, the differences in the % to 70 and to 100° C. would be largely eliminated. With the gasolines under consideration it may be expected that the addition of 7% pentane with about 90% iso-content would increase the vapor pressures by about 0.1 atm, the octane numbers and residual gasoline octane numbers by 1.2 points, and the minimum of the overload curves by about 1/2 atm. The quantities of light ends (Gasbenzin), principally C_5 hydrocarbons, obtained in the individual cases, but not added to the gasolines, (they would have been available for adjusting the vapor pressure), are given in Table 3.

With the 6434 gasolines cut off at 135° C end point B_4 quality is obtained. The quality of the gasoline from Bruchsal oil is somewhat inferior to that from Rumanian oil and, therefore, rather low, but could have been improved to some extent by adding light ends.

The cracked gasolines are of somewhat better quality than the 6434 gasolines, largely because of their higher aromatics content of 17 to 25%, against 6 to 7% for the latter. B_4-quality is easily obtained from Bruchsal oil; after hydrogenation the quality is even somewhat above B_4. The cracked gasoline from Rumanian oil is distinctly better than that from Bruchsal oil, about half way between B_4 and C_4 quality before, as well as after, hydrogenation. It may be recognized at the same time that the octane numbers do not represent a sufficient measure of quality, because the octane number of the samples from Bruchsal oil was higher than that from Rumanian oil.

That the better quality of the cracked gasolines is actually essentially based on their higher aromatics content and not on the smaller differences in the residual gasoline octane numbers determined above can be recognized by considering the 6434 gasolines dehydrogenated in their upper fractions, which attain C_1 quality with 32 to 35% aromatics and are, therefore, considerably better than the cracked gasolines. The influence of the raw material is only slight in this case too. By correcting the boiling curves and vapor pressure one can estimate that C_1 quality is barely obtained with Bruchsal oil, while it is readily obtained with Rumanian oil. As would be expected, the influence of the raw material is alike in all 3 cases and of the same magnitude.

5. Comparative Yields.

A comparison of quality of the gasolines obtained by various processes would be incomplete without a simultaneous comparison of yields, which is also given in Table 3. It was not considered necessary to repeat the detailed data from which these figures, intended only to give an approximate idea, were derived, because the derivations are based on a number of estimates. For example, the 6434 gasolines from Bruchsal and Rumanian oil were dehydrogenated with 2 different catalysts, from one of which extremely high gasification was obtained, (see Table 2 and remarks to it), so that the actual results could not be directly compared. Furthermore, the gasification of only 6% obtained in the benzination of the Rumanian middle oil to gasoline with an end point of 200° C was unlikely low, so that we figured on a higher value of 9%. Finally, in the cracking experiments the quantities of coke and manipulation losses were not accurately determined.

The yields based on 100 parts of split middle oil, i.e. on the middle oil fed in hydrogenation, or on the middle oil fed less the B-middle oil obtained in cracking, decrease in the order of 6434 gasoline, dehydrogenated 6434 gasoline and cracked gasoline, whereby the second difference is considerably greater than the first, which, however, is partly balanced by the simultaneously greater butane content and the equally greater isobutane content, absolute, as well as percentagewise. In general, the yields are better in the processing of the H_2-poorer Rumanian oils, wherein the quantities of butane decrease only slightly in the hydrogenation gasolines but appreciably in the cracked gasolines, since, in the latter case, the composition of gasification is simultaneously shifted to the detriment of the butane.

In conclusion it may be said that, with petroleum middle oil feed as well as with bituminous coal prehydrogenation middle oil feed, the quality of cracked gasolines can readily be attained by benzination and subsequent dehydrogenation of a small partial fraction, with the additional advantages in yield and complete processing of the middle oils.

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Table 2: Benzination & Dehydrogenation.

Feed Oil	Hi-Oil from Bruchsal Oil				Hi-Oil from Rumanian Oil			
	6434-Gasol. -170°	6434-Gasol. Fraction -105°	6434-Gasol. Fraction 105-170°	DHD-C.C.P. Product from	6434-Gasol. -170°	6434-Gasol. Fraction -125°	6434-Gasol. Fraction 125-170°	DHD-C.C.P. Product from
Converter	316			303/II	316			303/I
Date	9.-12.10. + 27.-29.12.41			1.-4.1.42	30.12.-2.1.42			11.-13.1.
% of Overall Gasoline	—	(50)	(50)	—	—	50	50	—
Catalyst	6434			7360 J Nr. 4677 20	6434			7935 F.1-5 +12-17 20
Press. atm	200				200			
Temperature mV	20.5/18.5			27-27.5	19			27-28
Thruput kg/Ltr/h	1.2 - 2.0			0.5	1.2			0.5
Gasol. concentration %	55 - 78				66			—
Yield	0.81-1.10				0.74			
Gasif./Gasol.+Gasif.	11.7-15.2			30 1)	6.1 3)			15.7-16.8 2)
Gasol (unstabilized)								
Spec. Grav./20° C	0.718	0.671	0.756	0.780	0.726	0.693	0.774	0.795
Aniline Point I	+ 57.2	—	+ 56	+ 3 ber.	54.5	+ 56.3	+ 50	—
Aniline Point II	+ 63.5	—	—	+ 65	—	+ 61	+ 64	—
ASTM Begin °C	32	26	113	28	28	29	125	35
% - 50	7	26	—	8.5	6	14	125	2.5
% - 60	13	41	—	12	10	26	—	5
% - 70	18.5	56	—	17	14	38.5	—	7
% - 100	37	90	—	31.5	33	78	—	20
% - 110	44	94	—	36.5	36	88.5	—	26.5
% - 120	51.5	—	6.5	44.5	40	98	—	34
% - 130	59	—	25.5	55	46	—	42	45
% - 150	74	—	59	75.5	58.5		46	69.5
% - 160	82	—	73.5	82.5	66		65	81
% - 170	88	—	84	86	73		81	89
End Point °C	185	116	195	231	203	150	190	209
Gas Loss	3.2	3.1	0.5	4.0	4.5	1.6	1.0	2.5
Composition								
%/wt. Paraffins	71.5	—	—	30	—	64.5	65.4	—
%/wt. Naphthenes	20	—	—	6	—	27.2	16.3	—
%/wt. Aromatics	7.5	—	—	61.5	—	6.3	16.8	—
%/wt. Unsaturated	1	—	—	2.5	—	2.0	1.5	—
Redistillation) After mixing with the light gasoline				10 %				4.3 %
Stabilization Losses) belonging to it.				7.3 %				4.7 %

1) The catalyst used gave an abnormally high gasification, similar to other experiments with it. Furthermore, a lower gasification would have been possible with the very H_2-rich feed gasoline by lowering the pressure in the DHD stage. In large scale production a yield of 77% could be expected, which was also used in calculating the yields in Table 3.

2) In large scale production a yield of about 82% could be expected.

3) Abnormally low, more likely 9%.

Table 3: Product Investigation

Feed Oil	Mi-Oil from Bruchsal Oil P 1203				Mi-Oil from Rumanian Oil P 1490 fr 170-350° of 28.11.40 and 180-350° of 5.1.42			
Process	Benzination	Benzination + Dehydrogenation to 30% Aromat.	Cat. Cracking	Cat. Cracking Unsaturated Hydrogenated	Benzination	Benzination + Dehydrogenation to 30% Aromat.	Cat. Cracking	Cat. Cracking Unsaturated
Converter	316	303/II v.1.-4.1. + 316 27.-29. 12. - 105° (43:57) redist. -165°	701 (Dr. Free) Comp. Rep. 19837i Dr. Free 16.1.42	303/II	316	303/I v.30.12.- 2.1 - 125° (45:55) redist. -165°	701 (Dr. Free) Exp. 109 -148	308/1
Date 1941/42	12.-17.10. + 29.-30.12.			30.-31.12.	4.-7.1.			25.-26.1.
Catalyst	6434	6434/7360	6752	7360	6434	6434/7360	6752	7360
Press. atm	200	200/20	1	25	200	200/20	1	25
Temperature mV	20.5 & 18.5	~19/27-27.5	20.5	16	19	19/27.5	22	16
Thruput kg/Ltr./h	~1.2	1.2-2.0/0.5	0.45	0.7	1.2	1.2/0.5	0.45	0.8
Gasol. Concentration	~50	—	~35	—	~45	—	27	—
Gasol. Yield	~0.5	—	~0.12	—	~0.5	—	~0.11	—
Gasif + Gasol + Gasif.	~20	~12.5/~23	~36	<1	~15	~9/~18	31.5	<1
% Yield from 100 kg Mi-Oil	81	77	64	—	86	83	68.5	—
kg C_4	15	12	20	—	11.5	9	11	—
of which kg iso-C_4	10.5	7	17	—	8	5	9.5	—
Stabilized Gasoline								
End Point °C	135	165	155	155	135	165	155	155
Light ends going with it but not added to it	~6.5 %	~3 %	~6 %	—	~5 %	~3 %	4%	—
Spec. Grav./15°C	0.716	0.731	0.722	0.720	0.710	0.751	0.753	0.731
Aniline Point I/II	+56.2/61.5	+3[illegible].2/69	+47.7/64.1	+49/63.2	+56.6/61.7	+30.2/6	+41.7/63	+44.6/61.8
ASTM: Begin	45	42	42	[illegible]	43	51	45	46
% - 50	0.5	2.5	1.0	1.5	3	—	0.5	1.5
% - 60	4.5	18	11	10	9	2.5	7	7
% - 70	14	36	26.5	26.5	25	12	20	20
% - 100	56.5	67.5	55.5	61	62.5	47	54	53
% - 120	84	81	73	7[illegible]	86	67.5	72	74
% - 130	94	86	82	86.5	94	77	82	82.5
% - 140	—	90.5	90.5	93	—	[illegible]	88	90
% - 150	—	94	96	96.5	—	91	94	95.5
% - 160	—	97.5	—	—	—	95.5	—	—
End Point °C/%	136/98.8	165/99	155/98	153/97	136/97.2	165/97.5	159/98	157/98
Composition								
%/wt. Paraffins	66.5	51.5	62.4	63.5	68	47.5	55	57
%/wt. Naphthenes	26	15.5	15.1	18.5	25	17	16.5	21
%/wt. Aromatics	6.5	31.5	19.5	17	6	34.5	24.5	20
%/wt. Unsaturated	1	1.5	3.0	1	1	1	4	2
Iodine Numb. (Hanus 3e)	—	5.2	15.7	—	3.0	6.5	38.7	1.5
Vapor press. atm	0.407	0.549	0.494	0.453	0.407	0.339	0.400	—
% C	84.93	85.95	—	85.47	84.74	86.43	85.76	85.92
% H	15.10	13.85	—	14.60	15.28	13.50	14.1	14.09
C.F.R. Res.-Meth.	69.7	81.2	—	—	—	84.6	—	78
Mot.-Meth.	68.2	79.0	76	76	69.7	73.2	74.7	72
Mot.-Meth. + 0.12 % Pb	89.2	94.2	93.5	94	91.2	92.8	—	92.5
Overload	1/2 (Min.) - 1 atm below B_4	Min. 1/2 atm above C_1	3/4 atm above B_4	3/4 atm above B_4	like B_4 in fatty range slightly poorer	Min. 1 atm below C_1	Mean Betw. B_4 & C_1 in fatty range slightly poorer	like 6543, at Min. slightly poorer

Table 4: Residual Gasoline Investigation

Feed Oil	Mi- Oil from Bruchsal Oil P 1203				Mi-Oil from Rumanian Oil P 1490 170-350°			
Process	Benzination	Benzination + Dehydrogenation	Cat.Cracking	Cat. Cracking Unsaturated Hydrogenated	Benzination	Benzination + Dehydrogenation	Cat. Cracking	Cat. Cracking Unsaturated Hydrogenated
Residual Gasoline	estimated							
%/wt.	90	68	79.5	82	90	66	75	79.4
Spec. Grav./15°	0.707	0.682	0.696	0.695	0.701	0.703	0.705	0.705
Aniline Point I/II	-/+ 61.5	+ 62.2/63.4	+ 62.9/64.5	+ 63/63.2	+ 61.5/61.7	+ 60/62.1	+ 60/63.3	+ 61.6/62.6
ASTM: Begin °C	45	42	39	44	43	47	44	45
% - 50	0.5	5	4	1	1.5	1	1.5	1
% - 60	4.5	31	18	8.5	9.5	6.5	9.5	8.5
% - 70	14	51	22.5	33	24.5	22	16	25
% - 80	29	66.5	44	47	39.5	39	39	39
% - 90	42	78.5	54	58.5	51	53	51.5	52.5
% - 100	56.5	87	64	69	64	65.5	62.5	69
% - 120	84	94.5	78	84.5	86	85	78	79
End Point °C	134/98.8	140/97.8	153/97.2	151/97.5	134/97	154/98.2	159/98	155/98.2
Composition:								
%/wt. Paraffins	71.5	73.5	79	76.8	72.5	71.5	72	71.5
%/wt. Naphthenes	28	24	17.5	22.2	27	26	21.5	26.5
%/wt. Aromatics	} 0.5	1.5	2	0.5	} 0.5	2.5	4	1
%/wt. Unsaturated		1	1.5	0.5		--	2.5	1
O.N. Mot.-Meth.	66.5	72.3	69.7	72	70.2	68	70.5	69.2
M.M. + 0.12 % Pb	88.5	100	91.2	92	89.6	90.1	91.2	86
Residual Gasol. - 100°								
O.N. M.M./M.M. + 0.12% Pb	73.8/95	--	80/103.5	--	74.7/95.6	72.2/93.6	--	78/--
Residual Gasol. > 100°								
%/wt.	--		31.4	--	31	17.4	--	33.4
Spec. Grav./15°	--	--	0.745	--	0.746	0.747	--	0.746
Aniline Point I/II °C	--	--	+ 61.7/63.7		+ 60.2/61	+ 57.5/64.5	--	+ 59.7/61.4
ASTM: Begin °C	--	--	109	--	106	110	--	100
%-120°	--	--	25.5	--	52.5	20	--	46
End Point °C	--	--	160	--	142	166	--	163
O.N. Mot.-Meth.	54.7/80	--	47.3/75.2	--	56.7	--	--	5 .6/ --
Extract								
%/wt.	~7	31	20.5	16.5	7.2	31	21	18.8
Spec.Grav./15°	--	0.871	0.865	0.871	0.867	0.871	0.857	0.872
Aniline Point °C	--	-59.5	-55.8	-57.8	-56.4	-58	-51	-59.9
% Benzol	--	7	6.5	--	--	7	8.5	5
% Toluol	--	31	24	--	--	24	28	29.5
% Xylol	--	40	54	--	--	40.5	42	50
% higher Aromatics	--	26.5	15	--	--	28	17	15

Table 5: Decomposition of Fractions

Feed Oil	Mi - Oil from Bruchsal Oil P 1203					Mi-Oil from Rumanian Oil P 1490	
Process	Benzination		Benzination + Dehydrogenation	Cat. Cracking	Cat. Cracking Unsaturated Hydrogenated	Benzination	Benzination + Dehydrogenation
Fraction - 75°: %/wt.	27.6 1)	21.1	39.6	36.8	40	17.1 3)	22.4
Spec. Grav./15°	0.673	0.656	0.661	0.657	0.661	0.675	0.662
Aniline Point I/II °C	+58 / 61	+55.2 / 58.2	+58.4 / 62.8	+56.6 / 66.4	+62 / 64	+61.8 / 63.8	+59.5 / 61.8
ASTM Begin	18	34	35	36	36	42	36
50 % Point	43	48.5	49	49.5	52	60	51
End	81 / 90.8%	87 / 96.5 %	85 / 98.5 %	81 / 97.3 %	76 / 97.3 %	82 / 97.5 %	77 / 97 %
%/wt. Aromatics	3.5	2	5	12	2.5	2	3
O.N. M.M./M.M.+ 0.12% Pb	81.9/103	80.8 / 103	72.6 /102.4	83 / 102	81.9 / --	76.5 / 96.1	79.8 / 101
75 - 100°: %/wt.	12	32.1	23.7	18.8	17.1	17.5	23.5
Spec. Grav./15°	0.718	0.707	0.722	0.718	0.724	0.723	0.724
Aniline Point I/II °C	+55.7/59.8	+56.6/60.2	+46.8/60.4	+52.1/61.3	+52/59.8	+54.4/58.4	+49/59.2
ASTM: Begin	73	65	67	73	78	72	71
50% Point	87	82	82.5	85	87.5	79	84.5
End	108	105	101	104	104	107	103
%/wt. Aromatics	5	4.5	16	11	9.5	5	12
O.N.: M.M./M.M.+ 0.12% Pb	69.7 / --	73 / 92.8	73 / 92	74.7/92.5	72.5/ --	67.4 / 89.8	70.8 / 91.2
100 - 120°: %/wt.	10.9	21.4	13.4	10.7	17.9	19	17.9
Spec. Grav./15°	0.740	0.743	0.787	0.756	0.759	0.746	0.769
Aniline Point I/II °C	+52.7/59.4	+52.3/59.7	+12.7/60.3	+49.1/59.8	+42/59.5	+51.7/59.2	+29.1/59.8
ASTM: Begin	93	100	92	98	97	99	96
50% Point	105.5	107.5	106	106	106	107	106
End	116	120	122	124	124	123	122
%/wt. Aromatics	8	9	47.5	13	20.5	9	33.5
O.N. M.M./M.M. + 0.12% Pb	63.7 / --	63.2 / 86.8	73.6 / 88.5	72.5 / --	70.4/--	62/85.8	68/88
120 - 140°: %/wt.	16.5	24.7	10.6	19.4	13.3	17.4	17.4
Spec. Grav./25°	0.757	0.759	0.837	0.784	0.789	0.765	0.807
Aniline Point I/II °C	+52.7/61.8	+52.8/62.4	+24.1/+63.9	+38.5/63.4	+23.8/62.5	+50.5/61.4	+5.7/63.4
ASTM: Begin	114	120	110	118	121	121	118
50% Point	124.5	129	131	128	128.2	128.5	128
End	142	143	141	142	139	145	143
%/wt. Aromatics	11	11.5	81	28	41	13	55.5
O.N.: M.M./M.M. + 0.12 % Pb	55.8/79.6	52.6/77.5	86.8/--	70.2 / 83	67.4 / --	56.4/80	73.2/88.5
140 - 160°: %/wt.	13.1 2)		12.4	14.3		18.6	11.2
Spec. Grav./15°	0.771		0.868	0.794		0.845	0.801
Aniline Point I/II °C	+55/65.2		+42.1/+70.5	+29.3/67.8		+17.9/+69	+23.6/66.7
ASTM: Begin	136		140	140		142	141
50% Point	146		156.5	148		155.3	147
End	162		194	172		177	172
%/wt. Aromatics	12		95	40.5		78.5	44.5
O.N.: M.M./M.M. + 0.12 % Pb	43/73.6		94.5/--	62.3/--		84/91	67.4 / --

1) Decomposition of the unstabilized product, therefore 8.2% Dist.- Loss of Fraction.
2) End fraction 19.1% of 160-194°; 0.786; A.P. +59/69.8; 50% - 175°; O.N. 20/62.8.
3) Decomposition of the unstabilized product. Before this Fraction 28.6% to 50° was cut out, which were not investigated.